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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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The Wings Go Round

HOW aptly John W. R. Taylor has titled his contribution to this, our annual helicopter review. *The Toy That Grew Up*, he calls it; and how lustily the rotorcraft has thrived since da Vinci and Cayley set down their dreams as the most tentative of sketches and fashioned them so delicately in model form. Already the swift, safe helicopter airliner is with us, in prototype at least, as the incomparable Fairey Rotodyne. We have, too, Russia's mighty Mi-6, with its demonstrated power to whisk 10 metric tons deadweight to levels above 15,000ft, or to convey a hundred-odd chubby comrades on their peaceful occasions. The mammoth aerial cranes are with us also—Westland's Westminster, looking every inch the part; and the towering S-60 of Igor Sikorsky, who has wrought so long and so well to add such splendid tools to man's workshop. The Sikorsky company —and Westland too—foresee almost limitless possibilities for such great machines —among them the carrying of prefabricated houses and sections of bridges, and the delivery of goods between factories, airports, piers and railway goods yards. Already the American company is contemplating a swivelling seat for the pilot that will enable him to face rearwards and operate a separate set of controls while looking almost directly down the hoist on to the cargo.

The helicopter certainly has grown up. It has grown into a gentle Jumbo of the air, with a masterful mahout in a magic howdah.

The New Link

Вчера Британская компания воздушных сообщений в Европе, Б.Е.А., начала первую коммерческую службу воздухом между Великобриатнией и Советским Союзом.

Мы хотели бы пожелать как Б.Е.А., так и ее соучастникам в Аэрофлоте всего хорошего, и надеемся, что эта служба вызовет более тесное взаимопонимание между нашими двумя странами.

Which, being freely interpreted, means that *Flight* offers its best wishes to the new B.E.A. - Aeroflot service which was due to be inaugurated yesterday, May 14. Russia is the only major nation which has never, in the 40 years of British air transport, been served regularly by British airliners. The service is a reminder of the rôle which air commerce can play in the wealth and trust of nations.

If, notwithstanding present tensions over Berlin, it is true that a new spirit exists between the eastern and western co-habitants of Europe, then what better than that our appointed European flag airline should be free to trade on and in that spirit?

But let it not be thought that the value of the service is entirely political, or that the Russian stewardesses who last week offered round trays of Georgian wine and Tu-104 lapel-badges (see p. 662) signify an immediate *rapprochement* between the two countries. It so happens that B.E.A. are likely to find good business in the new service, which is from the economic point of view refreshingly unlike the rest of the Corporation's short-haul, highly seasonal operations. The Moscow service will be medium-haul, yielding a good revenue rate, and it will be virtually non-seasonal. Good luck to British European Airways' accounts, as well as to east-west relations.

FROM ALL QUARTERS

Wanted: Government Backing

IN his last report to shareholders as chairman of the de Havilland organization, Mr. W. E. Nixon (who on his retirement is being succeeded from July 1 by Sir Aubrey Burke, as recorded in *Flight* last week) has some disappointing news to give and offers a warning for the future. His address, circulated in advance of the annual meeting at Hatfield on May 29, begins bluntly with news of a fall in the company's 1958-59 net surplus of £486,000. This Mr. Nixon puts down to several factors: development and tooling of the Comet 4; current Defence policy leading to a reduced requirement for military aircraft; and the heavy cost of developing civil aeroplanes, powerplants and propellers. Successful operation of the Comet 4 by B.O.A.C. had "vindicated the decision" to proceed with it; but the company had been unable to achieve enough sales to make the project remunerative, and in particular had been unable to penetrate the American market. Nevertheless, de Havilland was going ahead with its associates in the Aircraft Manufacturing Co. on the design and construction of the Airco D.H. 121 for B.E.A.; though on the basis of numbers ordered by the Corporation and with "the absence of any kind of Government support," the terms of the contract were more onerous than anything D.H. had previously undertaken. Mr. Nixon pays tribute to "the friendship and practical assistance" of Hunting Aircraft and Fairey Aviation, the company's Airco partners.

His warning relates to the future of the aircraft industry, whose exports—currently running at £150m a year—he says must decline unless it receives backing on a scale bearing some comparison with that afforded to its competitors. The industry can hope to stand up to foreign competition only if Government policy "stimulates a demand for a sufficient number of transport aircraft" to justify spending "many millions" privately on such ventures.

Referring to the D.H. Engine Co. the chairman mentions the Gyron Junior, scheduled for the NA.39 "and for a supersonic research aeroplane still on the secret list" [presumably the Bristol T.188]. He adds that a pre-production batch of the helicopter version of the Gnome engine is "already well under way," with deliveries due to commence shortly. Mr. Nixon refers with pride to the selection of D.H. Propellers as prime contractors and co-ordinating authority for Blue Streak, and to the important part D.H. Aircraft is also playing in this work.

Viscount Templewood

AMONG his many other achievements, Viscount Templewood (formerly Sir Samuel Hoare, whose death on May 7 at the age of 79 we record with regret) was one of the founders of British air power. He was Secretary of State for Air twice in the inter-war years (1922-24 and from November 1924 to June 1929) and again for a short period in 1940 before being made ambassador to Spain. In 1927 he was appointed G.B.E. in recognition of his part in the first civil flight to India.

When he held the office, the functions of Air Minister covered both civil and military fields, and Lord Templewood was active in both directions. He venerated Trenchard and fought strenuously for the continued existence of the infant Royal Air Force; and, although not himself a pilot, he took every opportunity of flying on Ministerial business to promote public air-mindedness. He recorded his experiences as Air Minister in a book called *Empire of the Air: the Advent of the Air Age, 1922-29*, published in 1957 and dedicated to the memory of Lord Trenchard. In the foreword Viscount Templewood says: "If a volume of memoirs can have a hero and a plot, the hero of this book is the late Lord Trenchard, and the plot is the establishment of the Royal Air Force and the opening of the Empire airways."

Viscount Templewood was Honorary Air Commodore of No. 3604 Sqn., Royal Auxiliary Air Force, and the last photograph of him published in *Flight* (December 26 last year) was taken when he attended the squadron's dinner-dance in London.

Blackburn Golden Jubilee

A JUBILEE dinner was held by Blackburn Aircraft Ltd. in Hull on May 1 to mark the 50th anniversary of Robert Blackburn's entry into aviation and the half-century of existence achieved by the company he founded. The chairman and managing director, Mr. Eric Turner, presided; Maj. F. A. Bumpus, the longest-serving director, proposed a toast to the memory of the founder; and the health of the company was proposed by Mr. Freddie Wilkinson of the drawing-office staff, the longest-serving employee still with the company (he joined it in 1914). Two of the guests present, Mr. Harry Goodyear and Mr. Arthur Mason, joined Robert Blackburn's company when he inaugurated it in 1909. Some 250 employees attended the dinner, at which a large birthday cake surmounted by a model of R.B.'s first aircraft and with fifty candles round its base was carried into the darkened room. A souvenir menu depicted on its inside covers aircraft the company has produced from Robert Blackburn's first monoplane to the NA.39; and in the centre a portrait of the founder had opposite a quotation from a speech by Sir Roy Dobson describing him as "lovable but quite determined . . . one of those select bands of men who not only designed and built, but flew their own aircraft." A film of Blackburn aircraft, compiled from historical records, rounded-off the evening; and an advanced copy of the house magazine *The Courier* for May 1, 2009, had been published for the occasion—aptly anticipating the hundredth anniversary of Blackburn Aircraft Ltd.

Sir Richard Atcherley's New Post

Air Marshal Sir Richard Ll. R. Atcherley, K.B.E., C.B., A.F.C., who has joined Folland Aircraft Ltd. as sales director. He recently retired from the R.A.F. as A.O.C.-in-C., Flying Training Command. In a brief announcement of the new appointment in our pages last week Sir Richard's name was regrettably confused with that of his brother David, who lost his life while flying over the Mediterranean in 1952

Decca Radar for Wisley

ACCEPTANCE trials of the new Decca Radar MR 100 surveillance equipment have now been completed at the Vickers-Armstrongs airfield at Wisley, Surrey. The MR 100 provides gap-free coverage to 40,000ft and 100 miles on small fighter aircraft, operating in the 10 cm band and feeding 750 kW to a high-gain aerial. High data rate, with the aerial rotating at 10 r.p.m., high discrimination and freedom from siting limitations are claimed as important qualities of the MR 100. Its range performance has exceeded original specifications and aircraft have been brought to within one mile of touchdown without using any MTI to reduce ground clutter. Normally aircraft are handed over to Wisley's Decca 424 airfield radar for precision approach. Two fixed-coil displays for the MR 100 are mounted close to those of the 424. Each scope provides four range settings, off-centring and an interscan range and bearing strobe which can be moved to any part of the screen.

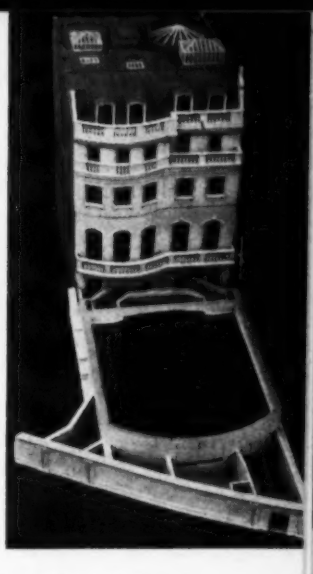
Vickers-Armstrongs have acquired this advanced radar, claimed to be one of the most important ever made at a manufacturer's airfield, in order to monitor directly the movements of their Valiants, Viscounts, Vanguards and Scimitars in relation to the neighbouring heavy civil and military traffic in the London zone and airways and from Farnborough and Odiham. It has already proved of considerable benefit in increasing the amount of useful test-flying carried out.

AIR MARSHAL H. L. CAMPBELL, C.B., C.B.E., Chief of Staff, R.C.A.F., in a Blackburn NA.39. His mentors are (centre) Derek Whitehead, chief test pilot, and Mr. N. E. Rowe, technical director. The Air Marshal's party included A. Cdre. M. Lipton (Director of Operations, R.C.A.F.), and A. Cdre. V. H. Patriarche (Canadian Air Staff Mission)

M. MAURICE TABUTEAU, managing director of the French company S.E.V., visited Filton on May 8—his first visit there since 1912. M. Tabuteau joined Bristol in 1910 and directed design work on the Type T biplane. He is seen with Capt. K. J. G. Bartlett, left; Mme. Tabuteau, centre; and his own Emeraude, background

SWISS-REGISTERED Scottish Aviation Twin Pioneer HB-HOX seen before delivery to the Swiss Government Survey Department recently. The delivery pilot was Capt. Hans Haefliger (second from left), and he is seen with Capt. D. A. Templeton (Scottish Aviation Ltd.), Mr. W. Fairweather (S.A. engineer), Mr. Fritz Hirzel (Swiss government aircraft inspector), and Mr. I. C. Reid (S.A. sales manager). The Twin Pioneer will be almost immediately engaged on high- and low-altitude photography for the production of topographical maps and plans for constructional projects. Two survey cameras will be fitted

NEW PRESIDENT of the Royal Aeronautical Society is Mr. Peter Masefield, here seen performing an additional duty—that of opening the National Gliding Championships last week-end; with him is Mr. Philip Wills, B.G.A. chairman. Right: model of the proposed R.Ae.S. lecture theatre adjoining the Society's headquarters (see "R.Ae.S. in the News," this page)



R.Ae.S. in the News

HONORARY Fellowships and Companionships, as well as several medals, were being awarded last night (Thursday, May 14) by the Royal Aeronautical Society on the occasion of the 47th Wilbur Wright memorial lecture. This was being given by Mr. C. J. McCarthy, S.B., F.I.A.S., chairman of Chance Vought Aircraft Inc., on the subject *Managing Aviation Technologies*. It represented the first formal function at which the Society's new president for 1959-60, Mr. Peter Masefield, had presided.

Mr. Masefield, managing director of Bristol Aircraft Ltd., was inducted by his predecessor (Sir Arnold Hall) at the annual meeting on May 7. This was held at the Society's headquarters, and Sir Arnold presented several awards for outstanding papers published during 1958 (details in column 2) before investing Mr. Masefield with the presidential badge.

Last night's meeting was being held at the usual venue for London main lectures, the Institution of Mechanical Engineers; but the Society plans to build its own lecture theatre behind its headquarters at 4 Hamilton Place, and has issued an appeal for £100,000. The whole scheme (an impression of which is given by the accompanying photograph of a very fine model made by Sir W. G. Armstrong Whitworth Aircraft Ltd.) is estimated to cost £150,000, one-third of which the council hope will be contributed by members and by the use of part of the Society's endowment fund. "For the balance," it is added, "we must seek support from our friends and from the aeronautical and associated industries." The opportunity to gain access to land at the back of 4 Hamilton Place arises from the Hyde Park Corner reconstruction scheme; and as access will be possible only while this scheme is being carried out, the opportunity to build will be short-lived.

* * *

Last night three Honorary Fellowships were being conferred, on Prof. J. Ackeret, professor of aerodynamics at the Eidgenossischen Technischen Hochschule, Zurich; Sir William S. Farren, technical director, A. V. Roe and Co. Ltd.; and Mr. S. B. Gates, chief scientific officer and consultant to the Director of the R.A.E. Two honorary companionships were also presented, to Mr. E. C. Bowyer, director and chief executive of the S.B.A.C.; and to Sir William Hildred, director-general of I.A.T.A. The awards of R.Ae.S. and other medals were as follows: —

Silver Medal, for work of an outstanding nature in aeronautics, to Dr. E. A. Watson (director, Joseph Lucas (Gas Turbine Equipment) Ltd.) "for his achievements in the development of turbine engine combustion and fuel systems"; **Bronze Medal,** for work leading to an advance in aeronautics, to D. G. King-Hele (R.A.E., Farnborough) "for his contributions to earth satellite orbital theory"; **British Gold Medal for Aeronautics,** awarded for outstanding practical achievement leading to advancement in aeronautics, to R. S. Stafford (technical director, Handley Page Ltd.) "for his outstanding practical contributions to aircraft design"; **British Silver Medal for Aeronautics,** awarded for practical achievement leading to advancement in aeronautics, to D. J. Farrar (chief designer, guided weapons, Bristol Aircraft Ltd.) and N. H. Searby (manager, guided-weapon research and development, Ferranti Ltd.) "for their practical contributions to the development of guided weapons"; **Wakefield Gold Medal,** awarded for contributions towards safety in aviation, to K. A. Wood (superintendent in charge at the Atomic Weapons Research Establishment, Orfordness) "for his practical achievement in the development and application of electronic aids to all-weather approach and landing"; **R. P. Alston Medal,** awarded for practical achievement associated with the flight-testing of aircraft, to A. W. Bedford (chief test pilot, Hawker Aircraft Ltd.) "for his contributions to the technique of flight-testing high-speed aircraft"; and the **N. E. Rowe Medal,** awarded for the best lecture given before any branch of the Society by a branch member, to J. Dunham (Rolls-Royce Ltd.) for his paper *Damage to Axial Compressors*, given before the Derby branch.

At the meeting on May 7 when Mr. Masefield was inducted, ten awards were presented for outstanding papers delivered last year or published in the official journals of the R.Ae.S.: —

Simms Gold Medal, for the most valuable contribution on any subject allied to aeronautics: R. P. Probert (deputy director, engine test facilities, N.G.T.E.), for his paper *Ramjets*; **George Taylor** (of Australia) **Gold Medal,** for the most valuable contribution on aircraft design, manufacture or operation: H. L. Cox (N.P.L.) for his paper *The Application of the Theory of Stability in Structural Design*; **Edward Busk Memorial Prize,** for the most valuable contribution on applied aerodynamics: T. R. F. Nonweiler (Department of Aeronautical Engineering, Queen's University, Belfast) for his paper *The Man-powered Aircraft—a Design Study*; **Orville Wright Prize,** for the most valuable contribution to *The Aeronautical Quarterly* on some subject of a technical nature in connection with aeronautics: D. A. Spence (R.A.E., Farnborough) for his papers *The Lift on a Thin Aerofoil with a Jet-augmented Flap* and *Some Simple Results for Two-dimensional Jet-flap Aerofoils;* **Herbert Ackroyd Stuart Memorial Prize,** for the most valuable contribution on aircraft propulsion: A. A. Lombard (director of engineering, Aero-engine Division, Rolls-Royce Ltd.) for his paper *Thinking about Aircraft Engines*; **J. E. Hodgson Prize,** for the best paper of a general nature, with emphasis on historical work: J. E. Allen (head of the aerodynamics, project and assessment department, Weapons Research Division, A. V. Roe and Co. Ltd.) for his paper *From Aviation to Astronautics*; **Branch Prize,** for the best paper read before a branch of the Society: B. D. Blackwell (engineering manager, Bristol Aero-Engines Ltd.) for his paper *Some Investigations in the Field of Blade Engineering;* **Navigation Prize,** for the best paper on navigation: C. M. Cade (research department, Kelvin and Hughes Ltd.) for his paper *Radio-astronomy and Navigation*; **Usborne Memorial Prize,** for the best contribution by a graduate or student on some subject of a technical aeronautical nature: Dr. J. S. Przemieniecki (Bristol Aircraft Ltd.) for his paper *Matrix Analysis of Shell Structures with Flexible Frames;* and the **Pilcher Memorial Prize,** for the most valuable paper read by a graduate or student: A. W. Kitchenside (Vickers-Armstrongs [Aircraft] Ltd.) for his paper *The Effects of Kinetic Heating on Aircraft Structures.*

IN BRIEF

Hunting Aerosurveys Ltd. have become the first U.K. air survey company to use the Marconi Doppler Navigator system, equipment for which is now installed in their aircraft.

* * *

At last Saturday's "open day" at Wethersfield, Essex, U.S.A.F. base a *Flight* representative was privileged to fly supersonically in an F-100F. His impressions will appear next week.

* * *

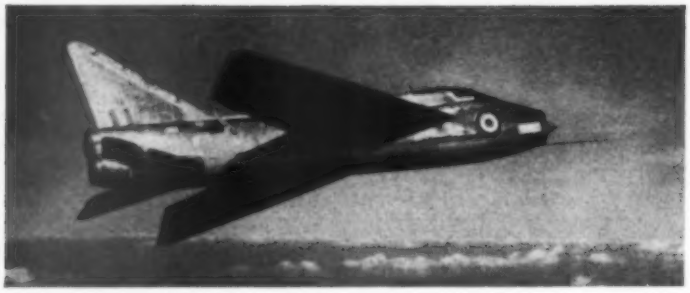
It is announced by the Armco Steel Corp. that its new steel PH 15-7 Mo has been selected as the main sheet material for the N.A.A. B-70 Valkyrie and F-108. A note on the B-70 wing appeared in our April 10 issue.

* * *

We regret to record an accident at Cardiff on May 7, involving the Dove G-ALEC, operated by Lec Refrigeration Ltd. as an executive aircraft. The pilot, Mr. Paul Chambers, and his three passengers were killed. Lec have for several years been keen operators of executive aircraft, and have an airstrip alongside their Bognor Regis, Sussex, factory.

* * *

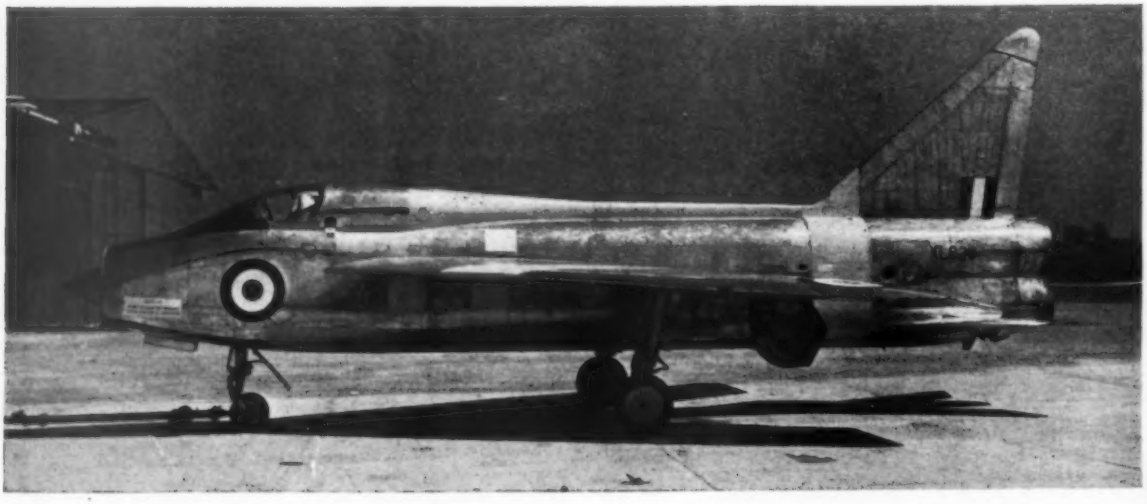
The recent appointments of Mr. A. N. Clifton and Mr. Maurice J. Brennan as assistant chief engineers—not, as inadvertently stated last week, assistant chief designers—at the Vickers-Armstrongs (Aircraft) Ltd. design organization at Weybridge are additional to those announced by the company last December. As now constituted, the aircraft design organization is headed by two Board members—Mr. B. E. Stephenson, director of engineering, and Mr. H. H. Gardner, technical director—and a special director, Mr. G. F. H. Hemsley, chief engineer (aircraft). Responsible to Mr. Hemsley are five assistant chief engineers—Messrs. E. S. Allwright, E. E. Marshall, D. Parker, A. N. Clifton and M. J. Brennan—as well as the chief structural engineer, Mr. D. James, and the design manager, Mr. E. J. Clark.



LIGHTNING FOR TWO

TWO WEEKS ahead of schedule, the first English Electric P.11 two-seat Lightning flew for the first time on May 6. Piloted by R. P. Beamont, chief test pilot and director of flight operations, the P.11 flew from Warton for 30 min, and went supersonic 15 min after take-off. Unpainted, except for yellow bands and a black anti-dazzle panel, the aircraft has the serial number XL 628.

Powered, like the single-seat Lightning F.1, by twin Rolls-Royce Avon turbojets with afterburners, the P.11 has side-by-side seats for two occupants, who in many rôles will comprise an instructor and pupil. The new variant will be employed as an operational pilot-conversion trainer, and will clearly also be capable of fulfilling certain other functions for which a crew of two is an advantage. It can carry all the operational systems and armament developed for the single-seat machine and has a comparable performance. Both versions are in quantity production for the R.A.F.



Missiles and Spaceflight

DOUGLAS DELTA

A launching vehicle to be known as Delta will be used in 1960-61 to fire equatorial satellites from Cape Canaveral, polar satellites from Vandenberg and to accomplish several "deep space missions." Douglas Aircraft Co. were last month appointed prime contractor for the vehicle, which will be similar to the three-stage Thor-Able, in a $24m contract from the National Aeronautics and Space Administration.

Delta will incorporate an improved radio-inertial guidance system, and will have active guidance control of longer coasting periods between second-stage burnout and third-stage ignition. A modified Thor will form the first stage; the second stage will house the guidance and will have an Aerojet-General engine; and the third stage will be a solid-propellant rocket by Allegany Ballistics Laboratory of Hercules Powder Co. Twelve vehicles are to be delivered over the next two years, and are intended as interim vehicles prior to the use of the family of really large boosters now being developed.

—AND CONVAIR VEGA

A $33m contract covering the design, construction, testing and launching of Vega rocket vehicles for space exploration has been awarded by the National Aeronautics and Space Administration to the Convair division of General Dynamics Corporation. Test flights should begin late next year, and the contract calls for the construction of eight Vegas by the end of 1961.

Initially developed under the auspices of the Advanced Research Projects Agency, Vega will be a three-stage vehicle. An Atlas will form the first stage, the second will be a G.E. Vanguard first-stage engine, and the third will be a new liquid-propellant engine now being developed by the NASA Jet Propulsion Laboratory of California Institute of Technology. The vehicle should be capable of launching a 5,000 lb satellite into a 200-mile orbit, of sending a 1,000 lb payload to the vicinity of the Moon, or of landing a payload of "several hundred pounds" on the Moon.

Contracts worth $4.12m for General Electric's second-stage Vega engine, and $3m for "integration, payloads and technical project supervision" of Vega by Jet Propulsion Laboratory, had earlier been announced by the Administration.

CANADIAN-U.S. CO-OPERATION

Co-operation in ionospheric research by satellites and sounding rockets between the U.S. National Aeronautics and Space Administration and the Canadian Defence Research Board was announced recently. Non-military projects will be handled, and the broad plan is for D.R.B. to adapt its instrumentation techniques to the requirements of the rocket vehicles to be supplied by NASA. The Board will also design equipment for use at Fort Churchill and other ionospheric observation stations in Canada to which rocket and satellite data will be relayed. The prime objective is to increase knowledge of the Arctic upper atmosphere.

PROSPECTS FOR MALKARA

This journal's special missiles issue of December 5 last gave the first details to be published of the history and design-philosophy behind the Australian Malkara anti-tank missile. It was stated that a number of rounds had been purchased by the British Ministry of Supply for evaluation on the trials range at Kirkcudbright, Scotland. These trials are now described as "successful" by the Australian Supply Minister, who last week went on to express the hope that Malkara would be bought in quantity by the War Office and by NATO. A large (200 lb) missile designed for launching from vehicles, Malkara was described by the Minister as "The West's most effective anti-tank weapon yet."

SS-10s FOR U.S. 7th ARMY

Since the cancellation of the indigenous Aerophysics Dart it has been apparent that the vast American missile arsenal has been deficient in having no anti-A.F.V. weapon. Admittedly, a number of studies for anti-tank missiles have reached an advanced stage, and development contracts for at least one all-American weapon are likely to be let shortly, but for the immediate future it has long been obvious that the U.S Army would have to buy a foreign weapon. The first such weapon subjected to evaluation tests was the Nord SS-10 (fully described in our issue of February 7, 1958).

Some hundreds of rounds have been fired by the U.S. Army, and it was announced last month that bulk quantities—probably involving many thousands of rounds—will be purchased from Nord-Aviation for delivery to the U.S. 7th Army in Western Germany. One of the dominant factors in the choice of the SS-10 is undoubtedly its immediate availability; the U.S. Army have also been evaluating the British Vickers V.891 Vigilante, but this is a much later design and its development is far from completed.

HOUND DOG FIRED

First air launch of a North American GAM-77 Hound Dog air-to-surface missile took place on April 23. The single round was successfully fired down the Atlantic Missile Range from a B-52 operating from Eglin A.F.B. Prior to this test a number of test vehicles, devoid of guidance or propulsion, had been dropped from similar aircraft.

ICBM WARHEADS

According to *Aviation Daily*, "the Atlas warhead packs about four megatons; the Titan about seven." The publication was reporting a statement by Gen. Curtis E. LeMay, U.S.A.F. vice-chief of staff, who described the ICBM warheads as "relatively small" in comparison with some devices carried by B-52s. A megaton in U.S. parlance is one million short tons, or 2,000m lb.

TITAN NO. 4

On May 4 the fourth Martin XSM-68 Titan ICBM was launched from Cape Canaveral. This was the first Titan in which the first and dummy second stages were intended to separate in the air, and the U.S. Air Force said later that it "appeared to accomplish its test objectives."

FORD'S FIRST MISSILE

It was announced late last month that the U.S. Army has chosen the Aeronutronic Systems subsidiary of the Ford Motor Co. to develop the Shillelagh small battlefield missile system. No precise details of the missile are yet available, but it is likely to be infra-red or radar command-guided, weigh at least 100 lb (making it too large for infantry use) and have a particularly straightforward design rendering it capable of rapid development.

LUNAR RESEARCH GROUP FORMED

A working group has been appointed by the National Aeronautics and Space Administration to conduct major long-range scientific explorations of the surface and environment of the moon. Headed by Dr. Robert Jastrow of NASA headquarters, the group is one of a number of NASA working units whose job is to correlate forthcoming spaceflight projects and experiments (previously announced were groups concerned with satellite beacons and orbiting astronomical observatories).

A number of establishments have proposed experiments in the lunar exploration series. Among these are the Army Ballistic Missile Agency, Applied Research Laboratory of Glendale, California, CalTech, Columbia University, Los Alamos Laboratory of the Atomic Energy Commission, JPL, the Texas Instrument Company, University of California, MIT, University of Chicago and the NASA Beltsville Space Science Center.

The statement of Government policy on a British space research programme which was expected to be made by the Prime Minister on May 7 was postponed for the clarification of certain technical points.

Richard E. Horner, Assistant Secretary of the U.S. Air Force for Research and Development, is to become associate administrator of the National Aeronautics and Space Administration on June 1.

Thor-Able and Atlas-Able firings towards Venus, scheduled for June 3-4, have been postponed by NASA following "engineering difficulties in both the payload and boost-vehicle systems." Also postponed was a Thor-Able shot intended to place an Earth satellite in elongated orbit reaching to 30,000 miles.

Recent contracts awarded by NASA include $540,000 for the U.S. Army Signals Corps for infra-red radiation and heat-balance experiment in the Project Tiros meteorological satellite, and $1.07m to Bell Aircraft Corp for "feasibility of a high-energy fluorine/liquid hydrogen rocket engine, including studies and hardware."

Aspects of spaceflight will be studied at a new research centre planned for completion in mid-1960 by the California division of Lockheed Aircraft Corporation.

According to G/C. W. E. Townsend, R.A.A.F., Australia is "considering five different systems, two British and three American" for her defence against guided missiles. The group captain returned on April 28 from a three-month tour examining anti-missile systems; he suggested that the Australian system would cost some £A2m, be located near Sydney and be operational in two years.

On May 7 the sixteenth Jupiter IRBM was fired by a U.S. Army team from Cape Canaveral. Ships were standing by 1,500 miles downrange in an endeavour to obtain infra-red pictures of the re-entry.

Boeing announce that the advanced IM-99B Bomarc area-defence missile has a range "nearly doubled, from 250 to 400 miles," and accordingly an effective defence area of over 500,000 sq miles.

The deputy director of the Advanced Research Projects Agency said last week that work on Mrs. V. (a contraction of Manoeuvrable and Recoverable Space Vehicle) would start "during the coming year." The project would take over where the NASA Project Mercury left off.

"Flight" photographs

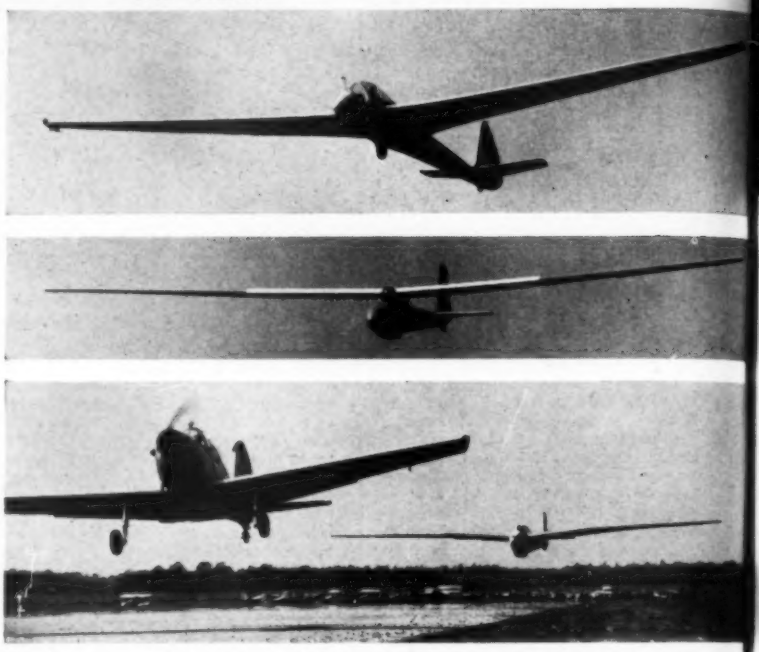
Gliding Championships Begin

A RECORD flight of 360 miles from Lasham to Portmoak, Scotland, is as good a way as any—and a better way than most—to open a gliding contest. When this coincides with the largest gliding championship ever held anywhere in the world, and with a brand-new bright idea in the shape of an international glider trade fair, it all adds up to quite an exceptional occasion.

This year's national gliding championships at Lasham were opened officially on Saturday, May 9 by Mr. Peter Masefield, who was deputizing for the Duke of Hamilton and Brandon, the chairman of the Air League. Amateur aviation had a great deal to contribute to the national effort, he said, and there was more enthusiasm in the gliding movement than in any other section of British aeronautics.

Inside Lasham's small new hangar, visitors to the international glider trade fair found a varied selection of glider equipment shown by some two dozen exhibitors. The new electric variometer designed by Peter Bulman and Peter Davy and now named the Crossfell was on show (five of these are being flown in the championships), and foreign participation comprised exhibits by Bréguet and the Polish agency Motoimport.

Championship flying in earnest began on Sunday, May 10, when the day's task for both leagues was declared to be free distance. The wind was south-easterly and there was the possibility of good flights to the north—but, for the benefit of those forced to land near Lasham, Mrs. Ann Welch (clerk of the course) warned pilots that if they came down in the foot-and-mouth-disease closed area just south of the airfield they might not be retrieved before May 23.



From the top, general view of line-up including Slingsby Swallow No. 98; Polish Jaskolka (J. R. Jeffries); Cdr. N. Goodhart's Skylark 3 taking off for Portmoak; R.A.F. Kranich (E. W. Clarke), launched by Chipmunk, which was later badly damaged on landing near Reading on the first day of the championships

First take-off was by Nick Goodhart in his red-and-white Skylark 3 at 10.42 a.m. The fleet of Tiger, Chipmunk and Messenger tugs did a smooth and efficient job of launching the gliders at the planned rate of one every 1½ min, but it soon became obvious that soaring conditions were not good. Between eleven o'clock and noon gliders were coming in to land again, it seemed, just about as frequently as others were being launched.

Conditions gradually improved, however, and the blue sky over Lasham was soon sprinkled with light puffs of cumulus which attracted a queue of pilots to the launch-point for their second and third attempts (a maximum of three contest launches per pilot per day is permitted). By early afternoon the landing reports began to come in, and the red-and-white pins on the control-tent map spread upwards like a rash over the Midlands.

Perhaps the first indication that this was to be an exceptional day came with the news that Geoffrey Stephenson (Skylark 3) had landed at Hawarden Airfield, Chester. Then in succession we heard of Derek Piggott (Olympia 403) at Sheffield; George Burton (Skylark 3b) at Dewsbury, Yorkshire; Bill Tonkyn (Skylark 3b) at Leeds; and 22-year-old Mick Kaye some 210 miles away at Lancaster with *Odin*, his Camphill syndicate's T.42 Eagle.

Three pilots, however, had beaten even these flights, as we learned during the evening as the final reports came in. Philip Wills made 272 miles to Woolsington, Newcastle-on-Tyne, in his Skylark 3; Mrs. Ann Burns (Skylark 3b) capped this with 283 miles to Hexham, Northumberland; and finally, incredibly, Nick Goodhart reached the goal he had declared that morning—the site of the Scottish Gliding Union at Portmoak, near Kinross, a distance of 360 miles.

Cumulus cloud-streets, cu-nims, and waves were each used by Cdr. Goodhart during this magnificent 6½-hour flight, which established new British national and U.K. local distance and goal flight records. Mrs. Burns beat her own previous women's records for distance and goal. The day's best flight in League 2 was 174 miles to Wakefield by Ted Stark (Skylark 2) of the Army Gliding Association.

KENNETH OWEN

(To be continued)

Below left, a general view of part of the international glider trade fair, with the Motoimport stand at extreme left; right, John Reussner answers prospective customers' questions on behalf of Slingsby Sailplanes

Ten months from now the sight of B.E.A.'s Vanguards at L.A.P.—in the new Corporation "red wing" markings, of course—will be commonplace. A foretaste was provided on May 6 when G-APEA, seen here, departed thence on a Vickers sales and demonstration mission to Hamburg's "overseas day." Full test instrumentation and a flight test team were carried: the aircraft reached a 440 m.p.h. cruising speed each way

AIR COMMERCE

Bermuda, Tokyo and all That

B.O.A.C. will get its foreign air carrier permit from the C.A.B. to include Tokyo as an intermediate traffic point on flights to the United States. Moreover, the United States has not yet broken any agreements, nor is it likely that she will do so.

By HAROLD CAPLAN
(Lecturer in Air Law, City of London College)

HOW is it possible to be so confident, when, at the moment of writing, the C.A.B.'s final decision is not yet known? The Minister, in the House on May 6, shared this confidence and gave as his reason the existence of a valid international agreement with the U.S. Is that all there is to it? And, if so, has the C.A.B. been wasting everybody's time?

Answers: "Yes" to the first question. "No" to the second.

Why the Permit will be Issued. *Flight* has already outlined the procedure whereby Tokyo was added to Route 7 under the IV (b) procedure of the famous Bermuda Agreement.[1] The magic of this Agreement is that the language is calculated to send lawyers crazy in a search for precise meanings; and yet it has proved a workable device as between two nations who, behind the scenes, understand each other very well.

The U.S. added Tokyo to one of their routes in October 1947, and we added it to one of ours in January 1957. If either nation had found that such an addition conflicted with the basic principles of the agreement so that the interests of its own carriers were prejudiced, then IV(b) procedure gives that nation the chance to protest and adjust the situation by negotiation.

No squawks emerged for the public record, so Tokyo was properly added to Route 7; this is not disputed by the State Department or by the C.A.B.

Although the Bermuda Agreement is an instrument of international law, i.e., one solely affecting relations between two sovereign States, it nevertheless contains references to the municipal law of each state. For example, carriers must obey all applicable *local* laws and obtain any necessary permits. This is where the fun starts.

In granting permits to foreign air carriers for carriage of the public, the President is supreme and *not* the C.A.B.[2] The C.A.B. could make an adverse finding; nevertheless the President can, and in the present case almost certainly will, overrule the Board.

Rôle of the C.A.B. in Foreign Air Carrier Permits. Although the Board is powerless to interfere with international air transport agreements once they have been concluded by the State Department on the authority of the President, it has a most important part to play in the negotiation of the agreement as well as in the issue of the subsequent permit.

Section 802 of the Federal Aviation Act of 1958 calls upon the Secretary of State to advise and consult with the C.A.B. (among others) concerning the negotiation of this type of agreement. Similar arrangements were in force at the time of the Bermuda Agreement (when indeed, the then chairman of the Board played a leading rôle) and when Tokyo was added.

The Board may issue a foreign air carrier permit if it finds that the carrier is "fit, willing and able" and that the "transportation will be in the public interest" (Sect. 402). But the issue or denial of such a permit is "subject to the approval of the President" (Sect. 801) and must be done "consistently with any obligation assumed by the United States in any treaty, convention or agreement that may be in force . . ." (Sect. 1102). The existence of the Bermuda Agreement has been recognized by the C.A.B. as a valid factor "in the public interest" in previous cases,[3] and was urged by counsel for the Board's Bureau of Air Operations in the present hearings.[4]

A previous Board chairman admitted: "It does begin to look a little—you might say—empty to have a public hearing and the formality of making a finding of a public interest after you have made an international agreement which pretty much covers the general basic problem of the cases."[5]

The C.A.B. has two bites at the cherry, once in the negotiation of the agreements and next in the grant of the foreign air carrier permit. But this enables it to perform the important function of publicly reviewing acts of the Executive in accordance with American law—which reflects the concern of Congress for regulated competition based on sound economics.

Did B.O.A.C. Apply in Good Time? At first sight it seems reasonable to apply in October for a permit not needed till the following May. Especially when it is so certain that the permit must ultimately be issued and "without undue delay."[6] But this is to forget that under American procedure any interested party may file objections and this inevitably delays hearings. If Her Majesty's Government were sufficiently certain of the future to add Tokyo to the routes in January 1957 it is difficult to see why the application for a foreign air carrier permit should be delayed a further 21 months. It is not sufficient to assert we were not ready. The Bermuda Agreement specifically says that the "agreed services may be inaugurated immediately *or at a later date* at the option of the Contracting Party to whom the rights are granted." The C.A.B. issued the Airwork permit before the airline had even purchased the necessary aircraft. The permit enabled it to proceed with the purchase.

The Merits of Northwest's Objections. Newspaper reports suggest that Northwest's objections were based on (a) the proportion of Fifth Freedom traffic involved and (b) the extent of diversion of traffic from American carriers. Although these are valid matters to be ventilated under American procedure they appear to be irrelevant in connection with the issue of a permit in accordance with the Agreement. The Bermuda Agreement is renowned for the fact that these matters *need not be determined in advance* but may be (and are) dealt with by periodic retrospective review and consultation between the Governments.

References

(1) *Flight* leading article, May 1, 1959.
(2) C & S Airlines v Waterman Corp, 333 US 103.
(3) For example, the Airwork case, 18 C.A.B. 542 at 550.
(4) *The Times*, April 29, 1959.
(5) *Senate Hearings on Executive A, Committee on Foreign Relations*, February 20, 1945, p. 54.
(6) Article 2, Appendix 1, Bermuda Agreement.

The 54-seat tourist cabin and (see account below) the six-man flight deck

"Flight" photograph

AIR COMMERCE . . .

TU-104A PASSENGER'S NOTEBOOK

ON Thursday of last week *Flight* was among the party of journalists invited by Aeroflot to sample Tu-104A travel. A 45 min flight from London Airport at 11,000ft and a leisurely 300 kt over eastern England is not sufficient to qualify our staff-member as an expert in Tu-104 travel; but some selections from his notebook are worth recording:—

Well sprung, smooth taxying, sparing use of wheel brakes, excellent nosewheel steering manœuvrability. Take-off in 35 sec from 10R/28L, releasing brakes against full power, unsticking after about 6,200ft at intersection with 05R/23L. Fair climb gradient: about 400ft over B.E.A.'s base. Wheels up in 20 sec. Much publicized drabness of cabin furnishing fully endorsed—ludicrously out of keeping with the lines and finish of the aircraft—imitation wood fittings, gold-anodized aluminium "brass" racking with nets, etc. A Russian Charles Butler could save a ton weight. Spacious hotel-room-like washrooms and lavatories (self-flushing).

Three pleasant English-speaking stewardesses serving sweet white Georgian wine, plus caviare and Tu-104 lapel badges. Their galley amidships also spacious—the envy of Western stewardesses? All that wasted space and yet seating for 70 passengers—16 four-abreast in wide de luxe seats forward, 50 five-abreast aft, plus four. Emergency passenger oxygen very obtrusively and untidily installed—rubber pipes all over one's lap.

Climbed to 1,500 m (by the cabin altimeter) in 4 min. Flight crew of three pilots (under Chief Pilot Peter Soldatov, 12,000 hr, in right-hand seat), navigator, engineer and radio officer. Capt. Stanley Jones of B.E.A. also on the flight deck doing the R/T. Fascinating flap-action: four screwjacks, turning at about 100 r.p.m., plainly visible from our seat in the cabin until full flap extension. Capt. Soldatov later gave touch-down speed as 240 km (130 kt). Certainly seemed fast, though not hot, with quite hard braking causing expensive-sounding noises in the mid-ships galley.

Taxied in past Decca's Valetta 1 demonstrator, G-APKR, in which Col. Baskirov, leading the Aeroflot party, flew earlier. Significant?

The cockpit (see above) showed relatively little change from that illustrated in *Flight* for November 16, 1956. But of particular note were the rearrangement of the fuel- or engine-control panels in the roof and addition of a sliding switch-panel in the ceiling. Flight-director and coloured-globe artificial horizons are carried and the old gyro D.I. is replaced by apparently triplicated gyro-magnetic compasses. Extensive double-layered windscreen panels, electric heating in some panes and generous demisting-air ducts, plus several rubber-bladed fans, are noteworthy. The stick-top autopilot controller is absent. Extensive blinds and visors are fitted, together with many fixed and adjustable lamps. Various factors indicate use of a military radar for speed and drift-reckoning, and for mapping. The scope is at 3 o'clock in the nose blister. Old-model selector boxes suggest that only eight or twelve V.H.F. channels are immediately available. There are no signs of an area-coverage, pictorial presentation type navaid.

THE HERALD'S MOUNTAIN ECHOES

"NAGALAND is a largely mountainous country straddled with ranges whose peaks climb to 10,000ft; lush jungle stifles the lower valleys. Where most dropping zones are located, the slopes afford barely wing-tip clearance. Once over the ring of hills girthing the area the search for the D.Z. begins; an operation necessitating continuous low flying. Lesser offshoots of the main range jut out awkwardly in the limited path of flight, forcing the pilot to take rapid evasive action. With the controls sluggish at reduced speed, the drop is executed with no small difficulty. In quest of the dropping zone, the aircraft descends to 150ft. There is little room for pilot error. Acute claustrophobia, aggravated by a cloud-base frequently no more than 200ft, harries the crew. When the D.Z. is picked out, free-dropped and parachute-lashed packages are pushed out, the aircraft banked steeply for the turn-about and return-run over the target area. Rid of its burden, the Dakota is put into a steep climb to clear the mountain barrier at the end of the valley."

This quotation, from a forthcoming article on the Indian Air Force by a member of *Flight*'s staff,* gives an indication of the type of operation that may sometimes be required of a DC-3 replacement. The Handley Page Dart Herald G-AODF was recently initiated into D.Z. operations on India's Northwest Frontier during its 18,000-mile tour of India and the Middle East. Here is a report on the operation from Handley Page. In command was S/L. H. G. Hazelden accompanied by Capt. Dennis Warren of B.E.A. and I.A.F. and Indian Airlines personnel.

"Frontier flying began on April 18 with the Dart Herald's flight from Delhi to Srinagar. It was Capt. Balbir Singh who sat in the right-hand seat all the way through on the trip over a 9,000ft saddle of mountains into Srinagar. He knew the country like the back of his hand and was able to dodge round the mountains with confidence.

"On the morning of April 19 the Dart Herald was flown from Srinagar about 200 miles across the Himalayas to Leh, in a valley in the upper reaches of the Indus. The altitude chosen was 20,000ft—barely bringing the aircraft on a level with many of the peaks.

"Leh's airstrip, 10,500ft above sea level, runs steeply downwards (at the rate of 1ft in every 9ft) and terminates in a 500ft hill surmounted by a monastery. At the approach end is the mountainside.

"You fly downwind and can see the runway, but you then have to fly round a hill which is a good 1,500ft above the touchdown point. Here you fly between two hills with no more than a couple of hundred yards to clear through, turn round the larger hill on to the final turn for the run-in and once round you see the aerodrome again and make your approach. Practically throttled back, you find you are losing height at the same rate as the ground slopes. The surface is simply loose sand. It certainly wouldn't do for London Airport.

"With a weight of around 31,000 lb, an engine-cut take-off was performed from this strip. It was thought to be the only one ever recorded there. On the return the Dart Herald was flown between peaks on one engine to determine single-engine ceiling.

"On the following day the aircraft flew from Srinagar to Kargill, an airfield at 9,600ft in a 'cup' between the mountains. After some test flying it set another tight course between the peaks, overflying Srinagar and landing at Poonch close to the Pakistan border. Poonch has only 600 yards of runway, surfaced with large stones. Here again it was necessary to approach round hills (including the 4,000ft one which is 1,000 yards from the end of the runway) and out of sight of the short airstrip. Rajouri, an 800-yard runway at about 3,500ft, was also visited that day and presented yet another out-of-sight approach.

"On April 25, after revisiting Delhi and Calcutta, the Dart Herald continued its demonstration, which is likened to a shortened version of Boscombe Down trials, by showing its capabilities as a supply-dropping aircraft at Jorhat in north-eastern India. Free and parachute drops on the airfield there having proved successful, G-AODF was flown to a number of dropping zones in the mountains; there an aircraft's handling qualities are of the utmost importance.

"One of the D.Z.s proved to be a backyard attached to a little ring of huts perched right on top of a hill . . . a little pimple stuck up in the

**The first instalment will appear on May 29.*

middle of a bowl surrounded by mountains about 10,000ft high. There was very little room to turn. The mountains are all covered with jungle. It is a most peculiar sensation flying across a D.Z. which is virtually a solid piece of ground up in the air."

On a slightly extended itinerary the Dart Herald has visited Bangalore, Colombo, Bombay, Sharjah, Teheran and Diyarbakir. After calls in Ankara, Athens and Rome it is expected at Blackbushe on May 21.

INDUSTRY THOUGHTS ON SUPERSONICS

TWO and a half years after the Supersonic Air Transport Committee had its first sitting, the only proposals for a British supersonic transport on which any sort of agreement has been reached are that more recommendations should be made by more people. As a technical cross-section of research and industry, the S.A.T.C. made its recommendations on a basis of technical feasibility alone—an inadequacy that led Mr. Peter Masefield to suggest a new Cadman committee to make proposals after considering competitive and economic as well as technical factors.

The Minister of Supply, Mr. Aubrey Jones, has recently directed Air Chief Marshal Sir Claude Pelly, Controller of Aircraft at the M.o.S., to determine the extent of aircraft firms' interest, their readiness to contribute to preparatory investigations and the industrial organization they would recommend to undertake a supersonic project. Manufacturers are also being invited to give their individual views on "the type and speed of aircraft they would recommend." While the Minister is asking for a whole series of opinions, the Society of British Aircraft Constructors is attempting to speak collectively on the industry's behalf. The following is the text of their statement of policy on "The Supersonic Airliner Project":—

"The report of the Supersonic Transport Aircraft Committee does not examine the economic or prestige aspects of a British airliner travelling at about Mach 2 in company with a possible foreign airliner travelling at Mach 3. It was also beyond the scope of the report to examine the impact of the project upon Government policy of support for the Aircraft Industry's work at large.

"We have clearly reached the point where it is necessary to define specific directions of effort. Two main directions may be distinguished. First, there is investment in projects at subsonic speeds, where each project can be, and should be, judged primarily by the prospect it offers for sale of aircraft at home and abroad so as to achieve the fullest possible production lines and employment.

"Secondly, there is investment in projects which go into supersonic speeds, where the investment, judged by economic criteria, is less direct, though the indirect elements of research and development, and of prestige, are greater.

"We hope that it will be possible to pursue both directions of effort. It has to be recognized, however, that no aircraft firm could put risk capital into the development of supersonic airliners on the basis that it must recover costs and make a profit through sales to airlines. To the best of our knowledge, no American aircraft firm is venturing such risks, since the primary cost of development is being borne on account of military aircraft paid for by their Government.

"On the technical side nothing but good can come from active pursuit of the research and development problems associated with the supersonic airliner; from the manufacturers' aspect the financial and economic considerations have not yet been studied. In our opinion, economic and further design studies must be done if the various factors are to be properly assessed.

"In the years which lie between the present and the time when supersonic transports become available it is almost certain that there will be further substantial buying by the airlines. Unless the British Industry can obtain its share of those orders, the possibility of obtaining worthwhile orders for supersonic transports will be seriously prejudiced. We are convinced that a determined drive in the subsonic field must be regarded as a necessity."

A BRITISH UNIVERSITY OF THE AIR

AS forecast in a recent *Flight* article ("Club Training for Commercial Pilots," March 6) a National College of Air Training is now to become a reality. Air Service Training at Hamble is to be taken over by a subsidiary company formed by the Corporations.

Such a scheme—apart from implying the realization of schoolboy dreams—has long been advocated by those who are concerned that the very best possible pilot material should be available to British airlines; something of the sort was proposed 12 years ago by the Wilcock Committee; and, under the banner of the Air League, the Guild of Air Pilots and Air Navigators and the British Air Line Pilots' Association have since repeatedly stressed the need for an independent flying training college.

Nevertheless, the timing of the announcement is surprising in view of the number of qualified pilots at present unemployed or employed only on a casual basis. B.A.L.P.A. estimate that about 80 of their members (the largest number since just after the war) are at present looking for jobs, and numbers of other commercially licensed pilots—freshly qualified or not—are having to find other ways of making a living. The recession of 1958 has left a backlog of redundant pilots and it may take some time before demand outweighs supply, particularly as temporarily greater numbers of ex-Service pilots are searching for airline posts.

The Pilots' Association seems as hard pressed as everyone else to determine when the balance will be restored; but between now and the autumn of 1960, when the College will open, normal attrition should create a fresh demand. Nevertheless it is an uneasy thought that a pilot shortage has been "just around the corner" ever since 1947. In spite of these fears two factors make this a timely decision: the flow of national Service-trained pilots from the R.A.F. has almost dried up, and it has been clear for some time that the increasingly complex and specialized business of air transport requires that pilots should have a professional standard of training.

Formation of the College of Air Training was announced in Parliament on May 6 by Mr. John Hay, Parliamentary Secretary to the M.T.C.A., who gave the following details:—

"The college will be administered by a board of governors embodied under a trust deed and nominated by the chairman of the Airways Corporations and the Minister of Transport and Civil Aviation. B.I.A.T.A. has agreed in principle to participation in the scheme. It is proposed that the Board of Governors will be composed of the following members: One from the Ministry of Transport and Civil Aviation; one from the Ministry of Education; one representative expert on educational administration; three from British Overseas Airways Corporation; three from British European Airways Corporation. There will also be a provision to enable B.I.A.T.A. to nominate a Governor.

"The training [for cadets from the age of 18] will consist of about two years' duration in which flying instruction will be integrated with a thorough grounding in navigation, aerodynamics, meteorology, engineering and other aspects of airmanship such as aviation law. The aim is to develop to the fullest extent possible in each cadet those qualities of self reliance and dependability which go to make a good airline pilot. The cadets will be expected to live in. First-class sports and recreational facilities will be provided.

"Cadets will be sponsored by the airline operator requiring their services. Fifty cadets will be sponsored by B.O.A.C. for the first year. During the four following years the Airways Corporations are expected to sponsor a maximum of 110 new cadets each year. In the third year and onwards, therefore, the students will number about 220.

"The requirements of the independent airline operators and others cannot at this stage be precisely foreseen, but the college will be open to the nominees of all British airlines as their demands require.

"The cost of training each pilot is expected ultimately to be approximately £4,000 (excluding fees and board and lodging in the college, against which it is possible that maintenance grants from local education authorities may be available in appropriate cases). During the first two or three years, however, the cost per pilot will exceed this figure. The Government will contribute a grant of £1,000 per pilot trained, with extra assistance to meet the additional costs during the first two years. The sponsors will find the remaining sum of approximately £3,000 per cadet. State grants to the scheme are estimated to total approximately £100,000 to £120,000 per year from the outset.

"An announcement will be made in the near future explaining how prospective candidates should apply and the conditions of entry."

Britain's university of the air is thus being established very much along the lines proposed 18 months ago by Sir George Pirie of the Air League after consultation with G.A.P.A.N. and B.A.L.P.A.; there seems cause for regret that the pilot bodies are not represented on the board.

ATLANTIC TIDE RISING

AS cheering news about increased bookings had led everyone to expect, North Atlantic traffic in the first quarter of the year has shown a substantial increase over the same period last year. Passenger traffic has increased by 19.9 per cent, freight by 30.3 per cent and mail by 15 per cent.

Of the passengers carried, 65 per cent travelled economy class, 27.1 per cent first class and only 8.2 per cent tourist. First-class traffic increased by 11 per cent and traffic in the other two classes rose by 23.8 per cent; economy-class traffic thus gained substantially from tourist traffic and first-class travel lost in popularity to lower-fare travel.

Although slightly fewer flights were operated during January, February and March, aircraft average capacity increased, so that load factor—which averaged 55.8 per cent—rose a modest 2.8 percentage points.

New vehicles for ground handling: left, Commer 7-ton truck and Rootes Cargo Lift body, in use by PanAm for galley servicing at L.A.P.; centre, Blackburn mobile starter truck incorporating a Palouste power unit; and, right, freight being loaded into an Argosy with the Cargon wheeled pallet, which is secured to the aircraft by locking side-rails

B.E.A. ROUND THE WORLD

THIS is the second instalment (Part 1 appeared last week) of an account by the Corporation's chief executive of a 30,000-mile tour of potential ticket-selling markets overseas. Mr. Milward recounts here his experiences of aircraft services in Australia.

BY A. H. MILWARD

Chief Executive B.E.A.

PART 2

At London Airport on May 4, Mr. Milward greeted on behalf of B.E.A. the 32 Russian representatives of Aeroflot who arrived on a proving flight from Moscow in the Tu-104 *(see page 662)*

DURING our 11 days in Australia we visited Sydney, Melbourne, Canberra, Brisbane and Channel Country routes, the last-named being a subject that needs a chapter of its own. Of T.A.A.'s operations as a whole there is little to say, except that they seemed to be very well conducted. The present fleet of Viscounts consists of all 700 series but 810s are being delivered. At present there are 44 seats, four abreast, with no tables but reclining chairs. Light refreshments or meals are served according to the time of day. There is one toilet in the rear and a galley forward; two crew on the flight deck, with two stewardesses in the cabin. With one exception all flights operated on time.

During the whole of our stay in Australia the country was experiencing a minor heat-wave with temperatures varying between 91° and 106°. The Viscounts, in consequence, were very welcome because at heights of over 20,000 feet they were nearly always in smooth air and always cool.

On arrival at Melbourne, which is the headquarters of T.A.A., I was shown round their maintenance base by their chief engineer, and we certainly have nothing to learn in this respect. He is very grateful for help he has received—and still receives—from our engineering department, and this seems to be a recurrent theme throughout T.A.A.

On the passenger side it is interesting to note that T.A.A., who handle about one-third of our number of passengers or rather less (say 800,000 per year), have always worked on the system of allocating seats on all their routes. One of their staff confessed to me that, in his opinion, this lands them in nearly as many troubles as if passengers found their own—but it does eliminate the apron scramble.

Brisbane to Mount Isa. This was the highlight of my trip and, apart from the B.E.A. Sales Exhibition, was one of my main reasons for wishing to visit Australia. This service, operated by Dakota, is typical of those routes which T.A.A. run on a subsidised basis to carry food and supplies and provide a method of communication for the graziers living in the bush country of Queensland.

Before undertaking the journey I had been warned by all our Australian friends that this was really a case of "mad dogs and Englishmen." It was emphasised that no sensible Australian would visit Northern Queensland in January when the temperature is anything between 100° and 110° and the climatic conditions for flying terrifying. Everything I was told about the journey proved to be true. The flight by Dakota took 12 hours, with 11 stops. The departure at about 6 a.m. from Brisbane only served to belie what was to come. For the first long sector of 2¾ hours to Charleville the aircraft flew at considerable height and the air had not yet warmed up, so we sat in comfort eating a hot breakfast.

From then on the heat began to get oppressive and the route lay through bush country, the very names of the stops reminding me of Nevil Shute's novels. We flew via Charleville, Blackall, Long Reach and Winton (the birthplace of Qantas in the early days of Hudson Fysh). For nine hours the passengers were almost continuously strapped into their seats, the aircraft rocked and rolled continuously, the height was seldom over two or three thousand feet and the sectors between landing strips seldom exceeded half an hour. The outside temperature reached 103° and ultimately 106°.

The flying staff consisted of two captains and a first officer. At the landing strips the two captains carried the freight down the whole length of the cabin from the forward hold and handed it out to the farm manager, who drove his truck up to the aircraft. There were, of course, no airport staff. The first officer stood by the door and adjusted the load-sheet as freight was unloaded and more taken on. At this point the cabin temperature was 103°.

From a commercial point of view these services bear little relation to our own, even to our Highland services. They obviously have small commercial possibilities and are serving communities of from five to ten people only, at some of the stops. The strips are rolled out bits of desert, the only equipment being a windsock which to my eyes formed the only navigational aid, it being very difficult to recognise the strip from the surrounding desert. In wet weather the strips are frequently flooded, in which case unbreakable supplies are dropped through a small hatch which has been built in the door of the Dakota.

It was interesting to see that T.A.A. have never adopted airstairs in their Dakotas, a somewhat inexplicable decision as they would be most useful.

Once again the full impact of good flying weather was emphasised and this has a significant effect in reducing T.A.A.'s costs in the area and certainly the costs of the Ministry of Civil Aviation. There are no navigating facilities in this part of the world at all, the flights between the strips being done apparently entirely by dead reckoning and intimate knowledge of the terrain. All flying in these parts is by contact and in the unlikely event of bad weather the aircraft could divert to the nearest airport which happened to have a beacon.

I touched on the subject of Sydney earlier in this report. None of the airports I saw in Canada and Australia, or on my journey home through Singapore and India, served to change my mind about the depressing standards of airports in use in most countries today. Politicians in Australia are understandably not keen to have it said that they have provided themselves with a luxurious airport in the political capital of Australia, but the result is ludicrous. The "airport" at Canberra, the Federal capital, is a wooden hut which we would not accept were the M.T.C.A. to supply us with a similar one at Benbecula or Stornaway.

* * *

There is little to be said about the return journey which was undertaken by Britannia throughout, in great comfort and with the usual B.O.A.C. service. The aircraft was either early or on time throughout, with no hint of mechanical trouble.

Well, there are a few impressions of my extremely interesting and unquestionably valuable trip.

After nearly three years as chief executive of B.E.A., I felt a real need to get away from my desk and to learn something about other airlines of the world, and one can regard it as satisfactory, or the reverse, that I have not come back with any positive proposals for improving our own economics or operating efficiency, though there are many small ways in which we can make ourselves a better airline.

It was gratifying to learn that B.E.A. is well regarded abroad and is conducting its affairs in a manner which does not appear to be greatly bettered elsewhere. Indeed, I think we can claim to be as commercially minded as any airline in the world.

TURBOFAN DC-8s FOR K.L.M.?

FOLLOWING their startling leave-taking of Europair at the end of last month, K.L.M. made airline news again last week by announcing a probable increase in their DC-8 orders from eight to 12 at an additional cost of £9.4m.

At a shareholders' meeting at The Hague, Mr. I. A. Aler, the airline's president, announced that the purchase of four more aircraft was being negotiated with Douglas and that these aircraft would be powered with turbofans. It has also been reported previously that K.L.M. may buy eight medium-range jets for service in 1962.

These purchases are being considered against a financial background healthy enough for the airline to declare a dividend of 7 per cent on the 1958 accounts (profit on the year's operations was nearly £1¼m) although a deficit of £780,000 was incurred in the first quarter of the year. This was £85,000 more than over a

New Zealand's newest airport, on the Miramar peninsula five miles from Wellington, is to be opened on October 24. Nearly 200 houses had to be re-sited during construction of the single 5,350ft runway and a hill levelled to reclaim land near the water's edge

similar period last year and is attributed to the business lost after completion of the evacuation from Indonesia in January and March 1958.

Mr. E. H. Van de Beugel, at present special adviser to the Dutch Minister of Foreign Affairs, has been elected to the board of K.L.M. as member for management, and in January next year he will be made deputy president.

CATCH AS CABLE CAN

TESTS are to begin shortly at the U.S. National Aviation Facilities Experimental Centre at Atlantic City, New Jersey, with an emergency cable-and-hook arrester system for jet transports. If successful results are forthcoming from a six months' trial the F.A.A. may require the installation of the device at major U.S. airfields, and it might be possible (they say) to reduce recommended runway lengths for jet transports.

Various methods are to be tried, all of them adaptations of successful aircraft-carrier techniques (though tail arrester-hooks will not be used) and tests will be carried out with a full-scale mock-up of a jet transport undercarriage. It has already been proved possible to arrest aircraft travelling at about 115 m.p.h., but hooking steel cables around the mainwheels without catching the nosewheel poses some problems. One idea is to use the nosewheel to trip a pneumatic device that will throw a cable against the mainwheels, or a light cable might be used to catch the nosewheel and pull up the main cable in time to engage the main undercarriage.

In either case the cables will stretch to the side of the runway and momentum will be reduced by forcing pistons through long cylinders of water.

BREVITIES

B.O.A.C.'s tenth Comet 4 was delivered on May 6, two months ahead of contract.

* * *

The VIVA Shield, Gold Medal and citation are to be awarded to the de Havilland Comet by the Worshipful Company of Carmen at their July Court.

* * *

PanAm made a profit last year of £1,821,430 (5s 10d per share) on an operating revenue of £111,857,150. Profit for the previous year was £2,928,600.

* * *

The F.A.A. have approved the Allison 501s in Eastern Air Lines' Electra fleet for 1,000 hr overhaul periods. This is the longest time yet authorized for a U.S. civil gas turbine.

* * *

Silver City's scheduled service between Blackpool and Dublin starts today, May 15. Travel agents will be carried on the inaugural flight.

* * *

Mr. H. Worrall and Mr. C. W. Labette, respectively deputy chairman and engineering superintendent of N.Z.N.A.C., are to make an overseas tour this month to advise on a replacement for the airline's 26 DC-3s. It is reported that at least 11 aircraft will be needed.

* * *

Two West German aircraft firms have submitted designs to the German Economics Ministry upon which the aircraft manufacturing industry could be rebuilt. Hamburger Flugzeugbau have designed a 60-70 passenger medium-range jet and Heinkel a 20-25 passenger turboprop feederliner.

* * *

Panair, Loide Aero and Real, who carry 65 per cent of Brazil's domestic traffic, have announced fare reductions of 20 to 40 per cent to take effect over the next three months. The new fares apply only to domestic routes not subject to agreements with I.A.T.A. members and frequencies are being reduced by 15 per cent to fill seats. The aim is to recover passenger traffic lost as a result of recent big fare increases largely caused by a variation in the dollar exchange rate which affected equipment and fuel.

Under construction in Poland is the MD-12 feederliner (four 340 h.p. WN-3 piston engines) designed by the Aeronautical Institute in Warsaw for operation on domestic and international short-haul routes

The United Arab Republic has allocated £400,000 of its sterling balances for the purchase of a new Viscount for Misrair.

* * *

On May 6 an Alitalia DC-6B was required to land at Baghdad Airport while on a flight from Teheran to Rome via Beirut and Athens. The aircraft was later allowed to take off.

* * *

Air France are to operate direct polar services from Hamburg to Tokyo as from today, May 15. Super Constellations will be used until Boeing 707s are available in 1960. The outward journey will take 28 hr 20 min.

* * *

United Air Lines will supply Japan Air Lines with flight crews for J.A.L.'s trans-Pacific services from Tokyo. Services to Los Angeles will start on May 29 and a Great Circle route to Seattle on June 27.

* * *

An airport is to be built at Madeira and the seaplane base scrapped. The Portuguese Ministry of Communications gives as its reasons for these decisions the rough seas during the tourist season and the fact that flying-boats are going out of fashion.

* * *

Air Ceylon will inaugurate its new service to Canton "on the anniversary of China's October revolution" in the first week of that month. The airline now considers that an Electra would best suit its needs on this route and that if one were bought a second weekly service could be contemplated between Colombo and London.

* * *

Prepared under the auspices of the Royal Institute of Public Administration is the seventh volume in the New Whitehall series *The Ministry of Transport and Civil Aviation*. Written by Sir Gilmour Jenkins, permanent secretary to the Ministry, it is published by George Allen and Unwin Ltd. and costs 21s. There are 231 pages.

* * *

Discussions are in progress between M.A.T.S. and certain U.S. airline presidents about the design of a new freighter, to be jointly financed by the civil airlines and M.A.T.S. The member of the Senate Aviation Sub-committee who is urging the project, Mr. Mike Monroney, says that he is "seriously concerned" about America's ability to support a limited war in Europe, whether by M.A.T.S. or by the civil air reserve. He would like to see, according to *Aviation Daily*, a fleet of 400 turbine-powered long-range air freighters capable of carrying a 70,000 lb payload nonstop across the Atlantic at a direct operating cost of less than five cents per ton mile.

Straight and Level

I WONDER whether you are as puzzled as I am about the Supply Minister's latest move on Britain's supersonic airliner.

He has directed Air Chief Marshal Sir Claude Pelly to ask individual aviation companies for their views on the recommendations of the Supersonic Air Transport Committee. "It will be left open to individual firms," Mr. Aubrey Jones explains, "to give considered views on the type and speed of aircraft they would recommend."

Was not this the purpose of the 1956 Supersonic Air Transport Committee, upon which were eventually represented a total of 12 British aircraft firms? What are the firms concerned now going to tell Sir Claude that they haven't already told the Committee?

The Supply Minister will probably get as many technical and commercial recommendations as the number of aircraft firms Sir Claude consults. Then, of course, the Minister will have to appoint another Supersonic Air Transport Committee to co-ordinate all the views. And then Sir Claude will again be directed to ask individual companies for their views on the recommendations. . . .

And so it will go on, until my old friend Sir Charles Boost, firebrand champion of British supremacy in the air, decides to adopt U.S. nationality.

● Which reminds me: I have been thinking again about Britain's supersonic airliner policy, and I have decided that there is only one sensible course of action.

The Ministry of Supply should buy up Lockheed lock, stock and barrel, perhaps at the same time offering peerages and knighthoods to Lockheed's top management. I am not quite sure how much Lockheed would cost, or whether Baron Gross of Burbank or Sir Hall Hibbard would be prepared to work with the Ministry of Supply. But I am sure that this is the way to get the best and cheapest British supersonic airliner.

● In view of the carefully considered decision of the Canadian Government to throw away the Arrow and to buy the American Bomarc missile, I cannot help being interested in the view of Gen. Earle Partridge, C-in-C. of NORAD. Speaking before the House of Representatives in Washington, he said: "In my view the only way to assure the positive identification of unidentified objects on radar scopes is through the use of long-range intercepters."

But we must not get too discouraged. The science which threatens to become known as "missilonics" will soon produce a Bomarc which can formate on the source of a blip and say: "It's only a T.C.A. Viscount—one of their first batch of V.724s with stubby noses."

● Northwest Airlines said, in hearings before the American Civil Aeronautics Board, that if B.O.A.C. are allowed to include Tokyo in their Hong Kong - San Francisco service, about £5,356,000 revenue a year would be diverted from American carriers.

B.O.A.C., at the same hearing, retorted that the maximum diversion could not be more than £1,117,367 per year.

This sort of claim and counter-claim is routine stuff at hearings before our own Air Transport Advisory Council—usually in respect of controversies between Corporations and independents.

But—unlike the C.A.B.—our own A.T.A.C. has neither the staff nor the time independently to decide which side has the more reasonable claim. In the case of the B.O.A.C.-Northwest controversy, the C.A.B.'s Bureau of Air Operations did their own sums and decided that the diversion would be £1,786,000.

I do not record this to show that the American authorities are *not* standing in B.O.A.C.'s way on this particular issue. It's simply that I wish our A.T.A.C. had a proper staff capable of deciding scientifically which party in an air transport controversy is less wrong than another. How can it otherwise make correct decisions?

● This is a question, indeed, which puzzles me very much. And it prompts me to wonder whether you read the recent series of articles in *The Daily Telegraph* by an American road traffic engineer? Something he said about the way we tackle our road problems struck me as being applicable to the way we face our air transport problems. Here is what he said, slightly paraphrased:—

"A representative advisory council is no substitute for an executive agency which bases clear and consistent policy on adequate facts and research by trained specialists. . . . Without this isn't there serious danger of wrong policies, unwise decisions, and improper actions?"

As they say on TV quiz shows—he's *so* right!

● A member of Bristol's service department protests at my comparison of B.O.A.C. Britannia 312 and Ansett-A.N.A. Electra utilizations. You may recall my note that the former clocked-up 3½ hr per day after one year, and the latter 11 hr per day after one *week*. He thinks that this shows up the Britannia in a poor light.

I'm sure he will agree that it all depends on who is operating the Britannia. During the last 100 days Aeronaves de Mexico, for example, averaged 10½ hr per day with one Britannia while their second one was *hors de combat* for repairs after a training accident.

You need a pretty good aeroplane for that kind of utilization. In fact, I would go as far as to guess that no single aeroplane has ever produced so much air transport over such a long period—a capacity-ton-mileage equivalent to the normal three-month output of a fleet of 25 DC-3s.

● The most illuminating pages in the 44th annual report of the American National Advisory Committee for Aeronautics (now the N.A.S.A.) are those in which eminent men send special greetings to Gen. James H. Doolittle.

The Chief of Staff of the U.S. Air Force signs a letter written on a common, or garden, typewriter addressed to "Dr. Doolittle." The Assistant Secretary of the Navy for Air's letter is done on a machine with big, light-face, round type (and a rubber-stamp date), and it goes to "Dear Jimmy." The Secretary of Commerce adheres to an obviously much-battered instrument with archaic bold-condensed type-face, and he sends his regards to "General Doolittle."

The recipient, the renowned General Doolittle himself, is the proud possessor of an electronic typewriter, and his replies are immaculate.

● D.H.86 pilot to Dar-es-Salaam control: "Please may I land into wind? It's my birthday."

ROGER BACON

Meet the daring young men on the flying trampoline—Sgt. Quinney and Cpl. Portas of the R.A.F. School of Physical Training, St. Athan. I suppose they'll be trying it tied together next. Then, in due course, with coloured smoke

SERVICE AVIATION

Royal Air Forces and Naval Flying News

Honouring the Shah

HONORARY R.A.F. rank of Air Chief Marshal was conferred by the Queen on the Shah of Persia during his recent state visit to this country.

Nigerian Celebrations

THREE Avro Vulcans of Bomber Command and a D.H. Comet 2 of Transport Command are due to arrive in Nigeria today (Friday, May 15) to represent the Royal Air Force at the regional self-government celebrations in Northern Nigeria. The detachment will be under the command of A.V-M. G. A. Walker, A.O.C. No. 1 Group, and be based at Kano. During their five-day visit the Vulcans (from No. 101 Sqn.) are to give displays over Kano, Kaduna and Lagos and fly over the twelve provincial towns of the Northern Region.

Need for Encouragement

CO-OPERATION between the Royal Air Force and the aircraft industry, and the shortage of recruits for certain R.A.F. officer branches were two of the themes urged by speakers at the Pathfinder Association dinner held in London on May 7 (the eve of the anniversary of V.E. day). Mr. R. E. Hardingham, secretary and chief executive of the A.R.B., stressed the former topic in proposing a toast to the Royal Air Force. He recalled how the name of the Royal Aircraft Factory at Farnborough had been changed to Royal Aircraft Establishment so that its initials would not be confused with those of a then newly formed organization. He said he didn't know how we'd manage without the R.A.F., though the future—with its use of "misguided" weapons—looked less rosy. He still built his hopes on Transport Command and paid a great tribute to it, for without its experience with the Comet 2 the Comet 4 might not have been the success it is. Orders for the Britannic and Argosy were encouraging, but he would like to see ones for the Rotodyne and VC.10 and interest in a supersonic transport. The outstanding feature of the R.A.F. was its production of men, such as Trenchard, Bader and Bennett. (A telegram from A.V-M. Bennett expressing regret for absence had been read out at the start of the dinner by the president, A. Cdre. J. M. Birkin.) "When you in the R.A.F. stop giving us people," said Mr. Hardingham, "I don't know what we are going to do."

Air Marshal Sir Geoffrey Tuttle, the Deputy Chief of the Air Staff, said on the R.A.F.'s own manpower situation (when he responded to the toast) that it was getting the airmen it needed but not the officers. "We have got to sell missiles and space much more," he said, adding: "on the technical side we are not giving them enough jobs." On the whole, however, Sir Geoffrey reported that the R.A.F. was "in terribly good shape": it had got three new aircraft, a ballistic missile which would work and "one of our own which is going to work." He revealed that the first bomber aircraft ever scrambled from Whitehall had left the ground in three minutes; and the power and bomb-load of these aircraft were such that very few crews were needed, all of whom were pathfinders. Height, speed and range were much greater than those of the original pathfinders; and "you can do even better," concluded Sir Geoffrey, "if you leave the man out."

In welcoming the guests, Peter Swan mentioned with pride that the Pathfinder Club was self-supporting, and he concluded a comprehensive and friendly round of greetings with a special welcome to Air Chief Marshal Sir John Baker who was to reply to the toast. Sir John linked a tribute to the P.F.F. with the R.A.F.'s manpower needs. For the former, he quoted from Noël Coward's poem *Lie in the dark and listen* (date-lined May 14, 1943, 2 a.m.) the lines

> "There is a world you will never know,
> There is one debt you will ever owe."

The best encouragement to those coming on, said Sir John, was for the pathfinders to let them know what they believed in. "If we can give them the encouragement we can find the men."

Aerobatic Maestros

SIX R.A.F. flying instructors, selected to represent their units, vied with each other aerobatically at Little Rissington on May 7 for the Wright Jubilee Trophy. The winner was F/L. D. F. Moffatt, a flight commander at Cranwell; and F/L.s A. C. Doggett (from the All-Weather Jet Refresher Squadron, Strubby) and D. H. Mills (No. 8 F.T.S., Swinderby) were placed joint second. Judging was done by four members of the Central Flying School supervisory staff (G/C. E. James, W/C. P. W. Gilpin, S/L. H. A. Harvey and F/L. C. J. Holman) with the A.O.C. and Commandant, A. Cdre. J. N. H. Whitworth, having a deciding vote. The order in which the competitors flew was not known to the panel of judges, so each pilot was marked impartially on his performance of six set manœuvres and two minutes' free aerobatics.

As the main runway is being serviced at Little Rissington, the competing aircraft (all Vampires except for the Meteor flown by F/L. Doggett) took off from Aston Down. The set pieces were a loop, roll-off-the-top, slow roll to left and to right, eight-point roll and vertical roll; and F/L. Moffatt impressed by his neat execution of these aerobatics and those he volunteered, as well as by the good positioning of his display. F/L. Doggett completed his manœuvres with four splendid upward rolls and an interesting part of F/L. Mills' demonstration was his inverted climb.

After the contest, and before the competitors arrived by Anson from Aston Down for the trophy presentation, F/L.s J. Rhind and P. J. Hirst of the C.F.S. did some excellent synchronized aerobatics in two Jet Provosts (a show they are working-up for the Whit-Monday displays at Hucknall and Yeadon), and M. Plt. L. Gapper showed some Ranald Porteous-like ingenuity in his manœuvrings with a piston-engined Provost.

When the A.O.C-in-C. Flying Training Command, Air Marshal Sir Hugh Constantine, presented the trophy to F/L. Moffatt he congratulated all the competitors (deservedly) on "a first-class morning's flying"; and in particular he mentioned the winner's very good positioning and polished display. The trophy, presented to the R.A.F. by the R.A.F.A. in 1953 to commemorate the 50th anniversary of powered flight, is held for one year.

Three members of the R.A.F. mountain rescue team from Cyprus which did such a splendid job on Suphan Dag in Turkey where the missing Super Trader was found. Left to right, F/L. R. Robertson, the leader; F/Sgt. H. Appleby; and Sgt. J. Emmerson, a founder of the R.A.F. Mountaineering Association

Warning of Encirclement

IT is to the lasting credit of the R.A.F. that the university air squadrons have not, despite the severe cuts in other fields, been disbanded. So far, these most valuable units continue their excellent work although they are threatened with another review in about a year's time. But they have not altogether escaped the economy drive and have been reduced both in aircraft and member strength. The parent Home Command has disappeared and maintenance under contract by civilian organizations is apparently avoided wherever the R.A.F. can manage on its own.

The effect of these developments was clearly illustrated during the annual dinner of the Oxford University Air Squadron in Oxford last Friday. W/C. A. J. Douch, the C.O., recorded in his account of the past year's work that the Squadron now depended from C.F.S. instead of No. 61 Group, that its Chipmunk strength was greatly reduced and that flying had been moved from Kidlington to Bicester, *chez* No. 71 M.U. This year's summer camp was to be on the Isle of Man; and Air Chief Marshal Sir Theodore McEvoy, the Air Secretary, replying for the guests, reminded members that if they wandered from the Island and missed Ireland, America was the next dry land. He reminded them also that an R.A.F. coach for a victorious boat-race crew and an Oxford captain for a victorious R.A.F. inter-services rugby team were evidence of University-Service partnership. The final reminder was that the day of the pilot and navigator in what Air Marshal Sir Richard Atcherley, also present, had once jokingly called the future "uninhabited air force," was still assured and worthwhile. Furthermore, during recent heated discussions between the Ministry of Defence and the Admiralty it had been decided that a 60,000ft-high wall to separate land from sea was now impracticable—and Coastal Command would therefore stay with the R.A.F.

In a speech of quite rare and delightfully sustained humour, the Vice-Chancellor, Mr. T. S. R. Boase, proposed the health of the squadron and warned members of the forthcoming encirclement of the headquarters buildings by new centres of learning in the form of a law library, statistics and Anglo-Saxon faculties and the new St. Catherine's college.

Finally, Sir Theodore presented the flying proficiency trophy to P/O. C. M. Labouchere, the Hack trophy for the best all-round member jointly to N. D. P. Hughes and K. M. Waddell. A retiring young undergraduate later rode a small motorcycle quietly round the ante-room.

C. M. L.

Helicopters show their true value in places where ground transport is difficult; lumbering areas are an example. The aircraft is a Hiller 12E

Some 12,000 Helicopters have now been Built: Rotating Wings in Peace and War

By JOHN W. R. TAYLOR

THE TOY THAT GREW UP

OF all the different forms of aircraft flying today, the helicopter comes nearest to fulfilling the hopes and dreams of the pioneers. It alone possesses the freedom to fly anywhere; and the familiar gibe that its rotor is unnatural would be valid only if aeroplanes flapped their wings and motor cars walked on legs.

Even the work it has done in its young life makes sense, being directed more at improving mankind's lot in this world than in carrying weapons to speed his arrival in the next. Unfortunately, little of this work is of the glamorous kind, and the average newspaper reader is more used to seeing pictures of young ladies in swim-suits dangling from trapezes under helicopters than of the same aircraft saving from the ravages of blight the potatoes he eats.

For this reason the helicopter is still regarded generally as a toy or vehicle for stunts rather than as a serious, well-proven and thoroughly practical aircraft; and it is not until one begins delving deeply into the records of its manufacturers and operators that the magnitude of its achievements to date becomes apparent.

Going back for a moment to the very earliest days of flying, it is often forgotten that the first heavier-than-air powered aircraft which we *know* to have flown successfully was the helicopter model demonstrated by Launoy and Bienvenu before the French *Academie des Sciences* in 1784. News of this model helped to persuade Sir George Cayley to take an interest in aviation. His pioneering in turn paved the way for the first successful full-scale gliders and powered aircraft of Lilienthal and the Wright brothers. In the process rotors gave way to fixed wings and the Wrights certainly had no time for helicopters. In a letter to Arnold Fordyce on January 15, 1906, Wilbur wrote:—

"Like all novices we began with the helicopter (in childhood) but soon saw that it had no future and dropped it. The helicopter does with great labor only what the balloon does without labor, and is no more fitted than the balloon for rapid horizontal flight. If its engine stops it must fall with deathly violence, for it can neither float like the balloon nor glide like the aeroplane. The helicopter is much easier to design than the aeroplane but it is worthless when done."

The only part of that paragraph with which we can agree today is that the helicopter does its work "with great labor"—comparatively speaking. For example, to carry four persons at 124 m.p.h. in a light fixed-wing aeroplane such as the Cessna 172 requires an engine of only 145 h.p. To carry four at 107 m.p.h in a helicopter like the Sycamore *and* provide the ability to take off and land vertically demands an engine of 500 h.p. High power is synonymous with high initial and operating costs, and this has been the major hindrance to rapid development of the helicopter, because its greatest potential market is obviously as a civil transport, for which economics are all-important.

Fortunately, economy takes second place to expediency in the military field, and the new concept of speed and mobility that the helicopter has offered for duties such as casualty evacuation, combat-area transport and "plane-guard" rescue at sea has subsidized its development to the stage where it is now beginning to look attractive commercially.

Nor does the development period seem unduly long when we appreciate that it has taken a mere 20 years to advance from Sikorsky's VS-300, the first entirely practical helicopter, to the big, immensely promising Fairey Rotodyne of today.

So much for the background picture. Before filling in the details of what the helicopter has already done in two decades, it might be worth trying to estimate how many aircraft have been involved in doing it. Precise figures are seldom possible, because a high proportion of the overall production has been to meet military contracts; but the following notes on the output to date of the major manufacturers gives some indication of the total. In general, we must exclude prototypes; this accounts for the non-appearance of, for example, Fairey, Aerotecnica (Spain) and the Czech Aircraft Factory, whose production is not yet under way.

Great Britain

Bristol Aircraft Ltd. With production almost completed, the number of Sycamores built to date is **176**. The Type 192 is in production.

Saunders-Roe Ltd. Six Skeeters delivered to German Army, four to German Navy, many more to British Army.

Westland Aircraft Ltd. Total production of Dragonfly, Widgeon, Whirlwind and Wessex given as approximately **500**.

France

Sud-Aviation. By end of 1958 deliveries totalled 220 Alouettes and 100 Djinns, with production at rate of ten and five per month respectively. Total output should now be approaching **400.**

Germany

Bayerische Motorenwerke. Wartime production of Flettner Fl282 Kolibri totalled **22.**

Focke-Achgelis GmbH. Wartime production of Fa223 Drache totalled approximately 20. Post-war, two were assembled in Czecho-Slovakia as the Zavody Fa223 and one in France as the S.E. 3000.

Italy

C. A. Giovanni Agusta. Production under licence of Bell 47G, G-2 and J, since 1954, now approaching **400.**

Netherlands

Nederlandse Helicopter Industrie N.V. Number of Kolibries built to date is **11.**

Poland

The Soviet Mi-1 has been in large-scale production since 1956, under the designation of SM-1 and **100-200** have probably been built.

U.S.A.

Bell Helicopter Corp. Altogether 2,642 of the Model 47 series have been built since 1946 (including licence production in Italy and Japan), plus 53 HSL-1s, 13 R-12s, three H-15s and about 30 other helicopters of assorted types, making a total of approximately **2,740.**

Cessna Aircraft Corp. Evaluation series of ten YH-41 Senecas.

Hiller Aircraft Corp. Production of civil and military UH-12/H-23 series has passed the 1,000 mark, to which are added 15 YH-32/HOE-1 Hornets. Total approximately **1,050.**

Kaman Aircraft Corp. No figures available for production of HTK series. By February 1959, 81 HOKs and 24 HUKs had been built, with 18 H-43s due by mid-1959.

Sikorsky Aircraft. Production has included 131 R-4s, 131 H-5s, 225 R-6s (mostly by Nash), four H-18s, over 1,250 of the S-55 series, more than 100 of the S-56 series and more than 1,000 of the S-58 series, giving a total of over **3,000.**

Vertol Aircraft Corp. Production has included 339 of the HUP series, 20 HRP-1s, a number of HRP-2s, 270 H-21s for the U.S.A.F. and Army, 26 H-21s for W. Germany, six Model 42s and at least 16 Model 44s, indicating a total of well over **700.**

U.S.S.R.

Mil. The Mi-1 has been in production since 1951 and the Mi-4 since 1952. It seems likely that 1,000-1,500 of each have been built.

Yakovlev. First seen in 1955 in its military form, the Yak-24 is reportedly about to enter Aeroflot service. This may indicate that production has been limited to date.

From all this it is possible to make a fairly reasonable estimate that 9,000 production helicopters have flown in the West, with a "guesstimate" of a further 3,000 or so in Russia and Poland. As a matter of interest, this can be compared with a production total of just under 11,000 DC-3/C-47 aircraft.

Of the 9,000 Western helicopters, the Aircraft Industries Association of America estimate that 3,743 are in service with the U.S. armed forces, made up of 2,443 with the Army, 1,000 with the Navy and Marine Corps and 300 with the Air Force. The same source reported in January this year that 535 commercial helicopters were being used in the United States and Canada by 129 charter operators. This total was made up of 400 Bell Model 47s, 78 Sikorsky aircraft of various types, 26 Hillers, 21 Vertols, five Alouettes, three Kamans and two Westlands. To the total can be added nearly 100 executive helicopters delivered by Bell alone.

The United States and Canada therefore have in current operational service some 50 per cent of all the helicopters that have ever been built outside Russia. The biggest single commercial operator is the Okanagan Group of Vancouver, with 58 helicopters, made up of 36 Bell 47s, 21 Sikorsky S-55s, and one Sikorsky S-58. The largest helicopter airline in terms of passengers carried on scheduled services is Chicago Helicopter Airways with a 1958 total of 108,911 passengers. Largest operator of agricultural helicopters is Britain's Fison-Airwork company, with a fleet of 28 Hiller 360s.

So much for numbers of helicopters built and in service: let us now take a quick look at what they have achieved, beginning with military activities.

Back in World War II, experiments were made to test the suitability of the original production Sikorsky R-4 for anti-submarine work at sea; but the first regular duty taken on by the helicopter was probably as a "plane-guard" aircraft during carrier operations. So it is appropriate to begin with the story of Helicopter Utility Squadron Two (HU-2), the U.S. Navy's pioneer development unit for this type of work.

The squadron came into being on April 1, 1947, as VX-3, at the Naval Air Station, Floyd Bennett, New York. It was soon split in two, half going to Ream Field, California, as HU-1 and the other half to the Naval Air Station, Lakehurst, New Jersey, as HU-2. The latter has since become one of the largest squadrons in the U.S. Atlantic Fleet, with 600 officers and men and some 60 helicopters, comprising Bell HTLs and HULs, Vertol HUPs, Sikorsky HRSs and Kaman HUKs.

More than half of the squadron's personnel and aircraft are always at sea and their primary mission is search and rescue. The crews have become so efficient at fishing aircrew out of the water that on some occasions they have had their helicopter over a pilot within three seconds of his ditching, and the pilot inside the helicopter in 30 seconds. Normally the ditched airman is able to help himself into the "horsecollar" sling or on to the specially-designed three-prong seat lowered to him from the hovering aircraft; but one of the three-man crew is always ready to enter the water to help an injured man and several have lost their lives when the downwash from the helicopter rotor has entangled them in the parachute of the man in the water.

Because of the skill and courage of units like HU-2, U.S. naval airmen forced down at sea have a 19 to 1 chance of being saved, and this one squadron was credited with 486 rescues up to the end of April this year. (Its friendly rival, HU-1, is leading with 613 rescues up to March 1958, but had more crews in action during the Korean War.) In addition to rescue work, HU-2 is responsible for personnel, mail and cargo transport to and between ships at sea, ambulance flights, gunfire spotting, radar

One of the most widely used small helicopters is the turbine-driven Sud Alouette II; this example is being evaluated for the British Army. Below, first of the new family of Sikorsky amphibious helicopters—the turbine-driven S-62

"Flight" photographs

A Kaman H-43A and its crew attack a kerosine fire. Teams of this kind, stationed at U.S.A.F. bases, can usually be first at the scene of a crash. The rotor, kept turning, helps to beat back the flames

Standard transport helicopter for the R.A.F., the Bristol 192 employs tandem rotors driven by two gas-turbine engines. (Lower picture, left) The hovering voice: a Westland Widgeon employed by the Hong Kong police for crowd-control

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and gun battery calibration, photographic work, weather observations and many other jobs. Its helicopters made 17,359 ship-board landings during 16,561 flying hours in 1958.

To recapitulate, two U.S. Navy Squadrons have between them saved more than 1,099 valuable lives. Yet this represents but a small proportion of the total number of persons who would now be dead but for the helicopter. The figure of over 23,000 casualties evacuated by helicopter in Korea, often from behind the enemy lines, is well known. Less publicized have been some of the subsequent mercy missions.

When typhoon Ida struck the northern Izu peninsula of Japan, for example, scores of victims were airlifted to safety by Sikorsky S-55s and S-58s flown by U.S. and Japanese military pilots, who also carried tons of food and medicine to the stricken areas. When hurricane Diane hit parts of Pennsylvania and Connecticut, 44 Vertol helicopters flown by the three Services rescued 900 persons and carried 100 tons of supplies in 109,000 miles of flying over a period of a week.

The total climbs steeply when we add those snatched from areas stricken by earthquake in Greece and, in April this year, from villages of adobe huts swamped by flood in Uruguay, where a single U.S. Navy helicopter accomplished 31 rescues in 48 hours.

Sometimes only a single life is involved, as when a Bristow Helicopters' S-55 was flown into a 2,000ft canyon in the mountains of Iran, in conditions of extremely high temperature and turbulence, to pick up an American surveyor who had suddenly become critically ill. On other occasions the work is almost on a Korean War scale—as in Malaya, where No. 194 Squadron of the R.A.F. have carried to safety over 2,000 civil and military casualties in their Sycamores; in Cyprus, where No. 284 Squadron, also with Sycamores, evacuated over 220 casualties from hills and forests;

(Upper picture, right) The helicopter as a V.I.P. transport: Princess Margaret alighting from an R.C.A.F. Sikorsky H-34 to be greeted by the Governor-General during her Canadian tour last summer. (Right) Amid swirls of dust, an R.C.A.F. Vertol H-21 returns to a village in the foothills of the Rockies with an injured climber

and in Algeria, where French Army helicopters carried 2,309 wounded in one six-month period.

But—and here we must perhaps qualify a statement in the second paragraph of this article—the military helicopter is no longer non-combatant. Its potential as a transport for troops and supplies was tested in Korea, proven at Suez and is now an important factor in plans for both nuclear and restricted warfare. This was demonstrated operationally in its simplest form in Cyprus, where No. 284 Squadron dropped 3,271 troops in terrorist-frequented country during the emergency.

More spectacular were some of the items during the U.S. Army's two-day missile demonstration at Fort Bliss, Texas, and White Sands, New Mexico, last June. Three big twin-engined Sikorsky H-37s opened the programme by teaming up to deliver an Honest John rocket, its 4,000 lb launcher and a jeep and trailer containing assorted parts and tools, which were handled easily despite an altitude of 4,000ft and desert temperature of 100 deg F. Crews assembled the Honest John and it was fired within minutes, striking a target on a hill 11,000 yards up-range. Any illusions the spectators might still have had about that erstwhile "toy," the helicopter, were finally banished when a pair of Sikorsky H-19s flew in low to spray the target area with a total of 48 2.75-in rockets and machine-gun fire, closely followed by an H-34 which raked the desert with a further 48 rockets and bursts from two 0.50in and two 0.30in guns.

Important as such techniques are, however, they cannot compare with the greatest of all triumphs of the military helicopter to date—that of replacing fixed-wing aircraft completely for anti-submarine duties at sea. Already, in our own Royal Navy, the Gannet is giving way to Whirlwind 7s, hunting in pairs, with one helicopter carrying sonar gear and the other a homing torpedo. Later, the Whirlwind will itself be superseded by the turbine-powered Wessex, combining both search and killer rôles in a single machine.

For the helicopter to have taken over so important a duty so soon is a tremendous tribute to all concerned, not forgetting the designers of the lightweight sonar gear and torpedoes, and of the auto-stabilizers and blind-flying equipment that confer all-weather capabilities. What makes the changes so noteworthy is that it points the way to the time when every escort vessel will

Scooped: a Bristol Sycamore HR.14 of No. 275 Sqn., R.A.F., demonstrates marine rescue technique. (Right) Possibly the first helicopter to offer passengers an "airline-type" interior, the Vertol 44B is now in service with New York Airways

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be its own aircraft carrier, and great hopes are placed on the success of trials with an evaluation batch of Saunders-Roe P.531s from a frigate later this year. This shows that the Royal Navy is continuing its pioneering, as does the conversion of H.M.S. *Bulwark* into a helicopter commando carrier. Nor is the British Army overlooking the more offensive possibilities of the helicopter, for it is carrying out weapon trials that include firing medium machine-guns and Bren guns from the cabin of a Whirlwind and air-to-ground launchings of the Vickers Vigilant wire-guided missile.

Before we leave military helicopters, a story which arrived a few weeks ago from the U.S. Army seems worth recording, if only to demonstrate the versatility of helicopter crews and the hazards they face even in peace-time Canada. It seems that relatively mild weather last winter kept the Churchill River in Manitoba free of ice for longer than usual. Unable to make their customary migration over it, the local colony of polar bears not only camped near the Army's First Arctic Test Center at Fort Churchill but even invaded the post to scavenge through garbage cans. One poked his nose through the window of a radio shack; and the occupant, momentarily forgetting the Canadian game laws, attempted polar bear murder by rapping the inquisitive nose with a handy fire-extinguisher. The bear left.

Protected as they are by conservation laws, the animals were finally routed, not by gun-fire, but by the effective herding tactics of helicopters. The clamorous "choppers" descended on the bears, and directed at them the twin weapons of noise and rotor downwash, which routed the enemy without harming them in any way.

From animals (even polar bears) to farms seems a reasonable step and this brings us to one of the most widely-practised commercial uses of the helicopter—pest control. The pioneer in this field was the now-defunct Pest Control Ltd., which carried out what are believed to have been the world's first spraying trials with a Sikorsky R-4 in 1945. During the next two years it designed and built helicopter spray gear suitable for an S-51 and in 1948 offered the first contract spraying service in the Commonwealth with this aircraft. Today its successor, Fison-Airwork, is the largest operator of agricultural helicopters in the western world, claiming a total of 1,631,027 acres sprayed since 1948 in the United Kingdom, France, Switzerland, the Sudan, Ceylon, the Caribbean, Central America, Rhodesia and elsewhere.

This seems a pretty unglamorous business until one remembers how much depends on pest control in a world where insects eat or spoil a third of everything we grow, with further heavy losses from plant diseases. Then the news that Fison-Airwork have proved the ability of the helicopter to protect Jamaica's banana trees, which had previously been considered too delicate to withstand the rotor downwash, takes on an added importance.

So, coming back nearer home, does the work which Fison-Airwork, B.E.A. and other operators did last year when it seemed that blight would reduce the average yield of the potato crop in East Anglia from 12-14 tons per acre to two. B.E.A. decided to adapt one of their S-55s for the task; this was not easy, as nobody had previously used such a large helicopter for crop-spraying. Disregarding U.S. practice, they built a 23ft-wide sprayer-bar to be fitted over the aircraft's nose, giving the widest swath width in the world, and mounted a 110 gal tank for chemicals in the cabin, to permit 20 minutes of spraying per flight. After only the briefest of trials, the S-55 set out for a two-week attack on potato blight at Holbeach in Lincolnshire. From there it went on to Chelmsford, Lincoln and other areas, finally logging a total of 7,592 acres dealt with between June and August 13. As a result of this work, and that of other companies, some 56,000 of the threatened acres of potatoes yielded an average of over 10 tons an acre. Although some had to be treated five times, this was still cheaper for the farmers than losing their crop.

In many places, of course, it is still far cheaper to use fixed-wing aircraft than helicopters for agricultural work, and it would be foolish to expect helicopters of current design to compete with the aircraft used in New Zealand's booming top-dressing campaign. But where fields are small, trees and hedges numerous and landing fields few, as in Britain, the helicopter's manœuvrability and versatility offsets its higher operating costs. For more about this see *Flight*, April 3, pages 462-6.

Many techniques that were publicized as stunts a few years ago have become routine. Typical is the practice of flying slowly over crops threatened by frost, using the rotor downwash to force a warm blanket of air into the lower layers of cold air and so keep the temperature at ground level above freezing point. In areas where crops have been saved by this method, adjacent unprotected crops have often suffered up to 50 per cent loss.

Another highly effective technique is to spray chemicals over cotton crops to defoliate them for faster, more economical picking. Spraying by fixed-wing aircraft usually defoliates only the top 4in to 6in of vegetation, requiring a second application and a prolonged waiting period for the leaves to drop off. The rotor downwash ensures that spray is forced down to coat even the lowest leaves. The speed of such operations was well demonstrated in West Texas, where a single Bell 47 defoliated a 3,000-acre cotton crop in only 65 flying hours. One application did the job, and labourers were able to start stripping the cotton bolls from the denuded stalks only three to four days later.

Progressive cotton farmers in North Texas, by teaming up the helicopter with the mechanical cotton picker, have consistently delivered their cotton to the gin at a total cost of $18 per bale, as opposed to $45 by normal methods. What is more, each producer found that he needed only two men for the whole job, one to fly the helicopter and the other to work the mechanical stripper, relieving him of the time and trouble of dealing with field labour.

A Sikorsky S-58 conducts a complete pylon-erection operation in California, from transporting the ready-mixed concrete in a slung hopper, pouring it into the hole, and lowering the pylon into place

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The helicopter's ability to seed land is no less impressive. On a large-scale reseeding programme in Oklahoma, a Bell 47 distributed seeds at the rate of approximately 13 lb per acre, at an average of 7.27 acres per minute. Less than three hours of flying time were required to cover 1,200 acres. Similar work has been done in the past few weeks by another 47 operated by Hawk Helicopters, this time in Louisiana. As part of the biggest-ever pine forest direct seeding operation, the aircraft covered almost 6,000 acres in three days, leaving a further 14,000 acres to be seeded by fixed-wing aircraft. At the end the relative costs and efficiency of the two methods are to be compared; the result will mean a lot of business for somebody, as a total of 92,000 acres has to be seeded within the next three years.

America's forests are already making considerable demands on the services of charter operators in other ways. For example, during 1958 commercial helicopters flew almost 2,500 hours on firefighting and forestry patrol missions, and this work has grown into a $250,000 per year business in the state of California. In a programme aimed at increasing the effectiveness of the aircraft, some 11,400 small landing sites known as "helispots" have been cleared in national forests in that State, with an objective of 14,000 by 1961. The need for prompt action is emphasized by the computation that a brush fire can generate as much heat and energy in seven to ten minutes as did the atomic bomb dropped on Hiroshima.

If an outbreak is discovered in time it can be dealt with by a three-man crew despatched by helicopter and dropped at the nearest convenient helispot. More potent fires are "bombed" with water or firefighting chemicals. Full-scale fires are contained by spraying the timber or brush in unburned areas with solutions which will stop the fire. Before long a powerful new weapon may be added to the firefighting armoury—armoury in a quite literal sense, for the idea is to replace the warhead of Sidewinder air-to-air guided missiles with a solid-foam-type chemical capable of extinguishing high-intensity fires, and then to launch the missiles from a platform suspended beneath a hovering helicopter. The idea is by no means impractical, since the Sidewinder is an infra-red "heat-seeker" and would almost certainly home on the hottest part of the fire—though admittedly that is not always the best part to attack.

It is not so easy to accept a suggestion that similar methods could be used against fires in industrial plants, oil refineries and

Many Hiller H-23D Raven helicopters are employed by the U.S. Army: this example supports Nike missile bases in California

(Top) One of the three Bell 47D1s currently being operated by Autair Ltd. on oil exploration in West Bengal. The drill is boring holes for seismic shot-firing

A curious outline is presented by the U.S. Army Raven (small picture) engaged in salvaging portions of a crashed fixed-wing aircraft

(Left) Casualty evacuation en masse: the Fairey Rotodyne about to display its ambulance abilities at an Army demonstration

"Flight" photograph

Winter transport: a Bell 47 of Ostermans delivers the mail to a Swedish village

Most powerful "crane" helicopter in the Western world is the Westland Westminster, which is photographed lifting a three-ton section of pontoon

Standard light helicopter of the British Army is the Saunders-Roe Skeeter, which has also been supplied to Western Germany "Flight" photographs

chemical factories in populated areas; but that is not to say that the helicopter could play no part in civilian firefighting. The U.S.A.F. is going in for crash-rescue helicopters in a big way, with reported orders for 18 piston-engined Kaman H-43As, to be followed by 74 turbine-powered H-43Bs. Stationed at U.S.A.F. airfields, these aircraft are intended to haul asbestos-clad firemen and a 1,000 lb pack of foam chemical, axes, saws and special tools quickly to the scene of any accident. The firemen would then tackle the blaze, helped if necessary by the helicopter, which could beat down the flames with its rotor downwash. And, of course, the helicopter would be able to fly any casualties speedily to the nearest medical unit.

For such rôles the H-43 carries its cargo-pack slung under the fuselage at the end of a cable attached to a central quick-release hook. This ability to operate as a "flying crane" is one of the major advantages enjoyed by the helicopter compared with fixed-wing aircraft, because it means that the loads it carries need never be limited by the space inside its cabin. In fact, as the new Westland Westminster and Sikorsky S-60 demonstrate, a cabin becomes redundant in an aircraft that will be used solely for this type of work; it can therefore be dispensed with, to the benefit of the payload. The condition of the terrain also matters little to a crane helicopter. Where landings are impossible, it does not have to resort to air-drop, with consequent risk of drift or breakage, but can simply hover a few feet above the ground whilst loads are attached to or removed from its cargo-hook.

The possibilities thus opened up were demonstrated when Okanagan helped to build the Palisades Dam, high in the mountains five miles from Vancouver. There were no paths and no patch of mountainside big enough to land even a Bell 47; so the first task was to blast flat a ledge near the proposed site of the dam. Men, explosives and tools were put down at a suitable spot whilst the little helicopter hovered above the surface. Having built its own airfield, the Bell then made 40 round trips daily for more than a month, bringing in every pound of cement, every tool, man, generator and cement mixer needed to construct the dam. The larger items had to be ferried in pieces, as the helicopter's payload limit was 450 lb, but the job was done; and since then Okanagan have built up a reputation as the most experienced helicopter mountain fliers in the world.

Availability of helicopters of steadily-growing size has increased enormously the variety of jobs that can be tackled by crane helicopters. Powerline poles have been airlifted and dropped gently into previously-dug holes in almost inaccessible mountain regions; and a variation on this theme was the hauling by a single S-58 of 1,185,378 lb of steel for high-tension towers, in

Bell HUL-4 helicopters were employed by the U.S. Navy in support of Operation Deep Freeze; this HUL is taking off from Cape Hallett

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2,300-3,700 lb bundles, to construction sites in the mountains near Ventura, California.

Most spectacular job of this kind so far undertaken was, however, the recent construction of 12 high-voltage transmission towers in the California mountains, including the actual pouring of cement from the air, again by an S-58. First the helicopter carried in crews to dig holes in preparation for the cement footings. Then it lifted hoppers of wet cement and carried them from the base camp to the tower sites, where the cement was poured directly into the holes as the helicopter hovered. Following this, prefabricated tower sections were hauled up and lowered gently into place. Each cement hopper weighed approximately 3,000 lb, while the weight of the steel tower sections was 3,500 lb each. This must have been near the payload limit for the 13,000 lb S-58, especially at altitude, and it emphasizes again the possibilities opened up by machines like the S-60 and Westminster, which can handle loads of up to six tons.

The important fact to bear in mind is that the "flying crane" is no longer merely an airy-fairy idea, but is regarded as just another tool available for day-to-day use in America and Canada. The same applies to the use of smaller helicopters for power-line patrol in difficult country. This was one of the potential jobs that cropped up persistently in brochures for commercial helicopters in the late forties and early fifties, and was then regarded as being in much the same "believe it or not" category as lifting stone angels on to church towers and blowing rain-water off cherries with the rotor downwash to prevent their bursting in the later warm sun.

In fact, power-line patrol is big business today in many parts of the world, to the extent that some charter operators do little else. Philadelphia Electric Company, for example, patrol 440 line-miles of single and double circuit lines by charter helicopter on a regular basis. Air patrol is completed in an average time of 14-15 hours, compared with 37 man-days by ground patrol. Apart from saving some $200 per patrol, it has released two trained linemen for other duties.

Similarly, one or two men now handle all the patrol work on 1,200 line-miles per month on behalf of the Los Angeles Department of Water and Power, using a Bell 47; while the Southern California Edison Company has been able to reduce its ground patrols by 92 per cent with the aid of a helicopter, thereby cutting its inspection costs by 20 per cent.

The big advantage of the helicopter for this kind of operation, apart from the speed and ease of transport, is its ability to take a close look at any suspected break or damage by hovering or alighting virtually anywhere along the line. Repairs can sometimes be made on the spot, or help can be called in quickly in the case of major damage. Nor is this the limit of the helicopter's usefulness for these public-service companies, because many of them—such as the Hydro-Electric Power Commission of Ontario—also use their Bell 47s and Hillers to spray and destroy brush that would otherwise encroach upon the transmission line's right-of-way in remote areas.

Even more interesting was the snow survey carried out last winter on behalf of the Southern California Edison Company. The aircraft used was one of Hiller's new commercial Model 12Es, the 305 h.p. Lycoming engine of which permitted operation at full fuel-load even with landings and take-offs at over 11,000ft. Equipped with cargo racks for gear, snow-skis and short-range radio to relay findings to the home base, the 12E worked with a five-man hydrographic crew to find out how much water the company could expect the snow to produce for its hydro-electric complex during the spring thaw. In operation, the helicopter followed 13 pre-set courses over the snow-filled meadows throughout the greater drainage basin in the Sierra Nevadas, at altitudes above 8,000ft. With 10 to 38 samplings to be made on each course, it "leapfrogged" crewmen over one another to make the most of the short periods of daylight. At each stop the hydrographer took a sample of snow with an aluminium tube, the diameter of which was such that the weight of the snow core in ounces was equal to inches of water. The entire survey was completed in two days, with a total flying time of 5 hr 55 min, compared with the 10-14 days that would have been taken by men on snowshoes.

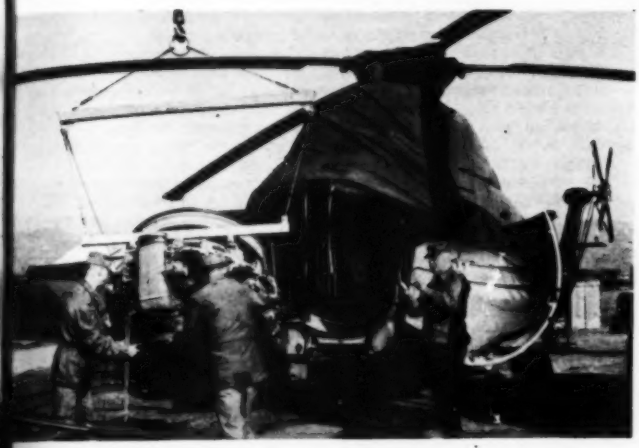
One of Bristow Helicopters' Westland Widgeons at Das Island in the Persian Gulf. It provides transport to the offshore oil-drilling rigs (one is seen in the harbour) operated by Abu Dhabi Marine Areas Ltd., in which BP has a two-thirds holding. (Right) Now going into U.S. Army service is the Bell HU-1 Iroquois, here undertaking casualty evacuation during a major field exercise

Surveying is, of course, no new departure for helicopters, but this particular job broke new ground in both its purpose and the height at which it was done. Many companies have concentrated for years almost entirely on long-term survey work, usually for oil companies, examples being Autair Ltd. and Bristow Helicopters Ltd. At this moment Autair have three Bell 47s in West Bengal which are being used in direct support of a seismic survey party. Their main task is to transport personnel, instruments, dynamite and portable drilling gear as the party moves across the country drilling shotholes, exploding shots and taking seismic readings; but the helicopters are also used for reconnaissance, and spend a considerable amount of their flying time moving water to the drilling sites during the dry season.

Bristow sent three Bells out to Bolivia in September 1957 for similar work on behalf of the Compania Petrolera Boliviana Shell

and the Bolivia California Petroleum Company. They proved so successful that three more were asked for in July last year. Utilization has been high, the three machines working for Bolivia California logging a total of over 340 hours in one month—a particularly creditable performance in view of the fact that the work entails flying into extremely restricted areas such as clearings in the jungle and river beds flanked with tall trees.

Another aspect of oil exploration work in which Bristow specialize is the ferrying of men and supplies between land and off-shore drilling rigs. Two of the company's Widgeons have been based on Das Island in the Persian Gulf since the Autumn of 1957 to serve a British Petroleum drilling barge anchored some 20 miles away. No figures are available to show the quantities of passengers and cargo carried in that time; but an idea of the vast scale of this kind of work on a world-wide basis is given by the fact that 160,000 passengers were carried by U.S. helicopters last year to and from drilling platforms in the Gulf of Mexico owned by Humble Oil and Refining Company. This is, of course, very much greater than the total number of passengers carried by the busiest helicopter airline in the same period.



These photographs depict Sikorsky S-58 helicopters undergoing routine maintenance. On the left is a U.S. Army H-34 in the front line, and on the right are commercial S-58s of Sabena

Nevertheless, the airlines have not been doing so badly since their activities were reviewed in the last "Helicopters of the World" special issue of *Flight*. As well as carrying a record number of passengers last year in their five S-58s, Chicago Helicopter Airways delivered their twenty-five-millionth pound of air mail and brought their accident-free flying mileage past the three million mark. Nor has the expansion slackened off this year, and on April 16 they established a new daily boarding record for the helicopter industry by carrying 620 revenue passengers, representing a 53 per cent load-factor on their over-100 daily services.

New York Airways have been doing equally well since they introduced into service a new fleet of five 15-passenger Vertol 44Bs a year ago. Because of their floats and sealed fuselage, these machines have made possible operation into Manhattan's 30th Street Hudson River heliport, and in the last six months of 1958 the airline's traffic results showed a tremendous jump, with a total of 55,266 revenue passengers and well over 1,000 tons of mail, express and freight lifted in the period. To achieve this, the Vertols each averaged 119.3 flying hours per month.

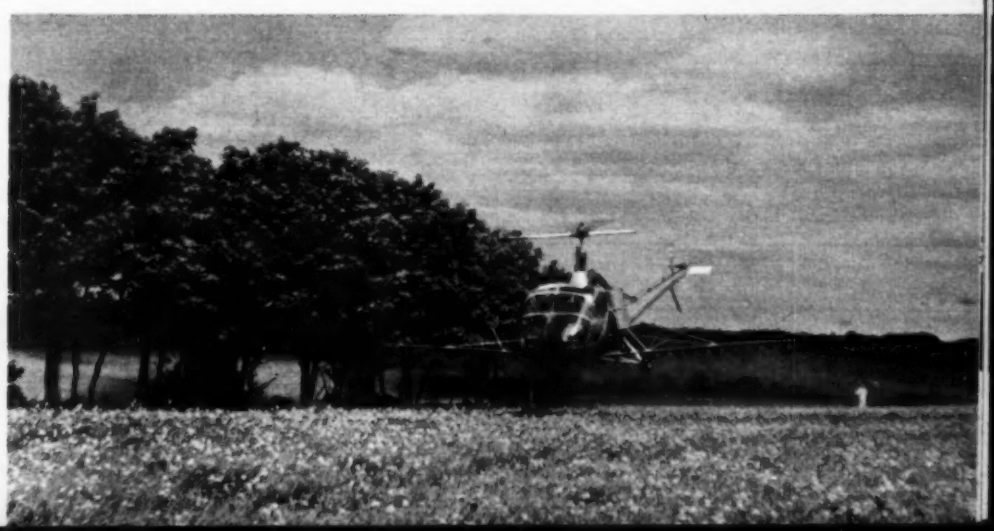
Sabena also recorded steady progress, their total of 117,858 passengers for the year being swelled by the 65,000 joyriders who obtained a striking view of the Brussels World Fair from the cabin of one of the Vertol 44s which the company added to its fleet of S-58s for the occasion.

One fact that emerges from all this is that the tempo of helicopter activity throughout the world is rapidly gaining momentum with the availability of new, larger and more trouble-free helicopters. By careful design and development, manufacturers in the United States are beginning to provide a life of 1,000 hours between major overhauls and this in turn is enabling operators to pass the magic figure of 1,000 flying hours per year. This may still seem small compared with the 3,000 hours achieved by some fixed-wing airliners, but it must be remembered that the helicopter wastes little time in taxi-ing, positioning and other non-productive movements.

Above all, perhaps, the progress denotes an awakening of interest among potential helicopter users which promises well for the future. Nor is the industry likely to be plagued any longer by the old bugaboo of a shortage of pilots, for very large numbers are being trained by the armed Services.

This brings us to the interesting fact that the world's largest helicopter operation is the U.S. Army's primary helicopter school at Camp Wolters, Texas, which is run in collaboration with a civilian company, Southern Airways. Equipped with a fleet of 180 Hiller H-23s, this school is responsible for the primary training of all U.S. Army helicopter pilots, plus employees of Federal and State Forestry, Wildlife and Soil Conservation Departments and military exchange personnel from America's allies. Up to 100 fully trained pilots graduate each month, to which must be added the achievements of a maintenance hour/flight hour ratio one-half of the Army average and a surprisingly unmatched safety record, even with inexperienced pilots making more than a quarter of a million practice power-off landings each year.

All of which should confirm the impression that the "toy" has not only grown up, but has grown up fast.



A Fison-Airwork Hiller Model 12 sprays a Berkshire cereal crop against weeds

This photograph, from a Hiller flown by R. Bradbury of Fison-Airwork Ltd., gives a good general impression of the scene at Woburn
"Flight" photograph

Rotorcraft Rally

SEVERAL types of helicopter at present employed on civil or Service duties in this country were represented at the first International Helicopter Rally, held in the park of Woburn Abbey last Sunday. There were two Westland Widgeons, one owned by the manufacturers and the other by Bristow Helicopters Ltd.; four Saunders-Roe Skeeters of the Army Air Corps; an N.H.I. Kolibrie of European Helicopters Ltd.; two Hillers of Fison-Airwork Ltd.; a Sud-Aviation Alouette under evaluation by the Army; two Westland Whirlwinds of the Joint Experimental Helicopter Unit and one of B.E.A. which gave joy-rides at 30s a head; and a Bensen Gyro-glider which did not fly. The display was organized by *Passenger Transport*. More participants had been hoped for but had to cry off for various reasons—for example, the recent grounding of Sycamores upset Bristol attendance. Now that a first event has been successfully held, however, it is possible that wider support will be given to another one.

This rally was held at Woburn by permission of the Duke of Bedford, for whom helicopters might be considered just so much more grist for his stately mill. But remembering the Duke's aeronautical forbears (his grandmother, the Duchess of Bedford, was a famous and far-flying pilot) it was not surprising to hear him say, when he declared the event open: "I have always been a great helicopter enthusiast." The Duke had been airlifted from abbey to airstrip by Hiller; he confessed he had never before seen the Woburn grounds from the air and said he looked forward to the day when helicopters cost less and he would be able to buy one out of half-crowns.

The display itself, held in perfect weather and ably compèred by Basil Arkell, began with one of the Hillers (flown by K. Sissons) demonstrating crop-spraying. A Widgeon with Alan Green as pilot gave such an energetic account of its manœuvrability that the commentator perforce remarked that it could be flown "quite smoothly" (i.e., straight and level), thus reassuring nervous potential passengers from Westland's heliport. The Kolibrie, with Mr. Robins in charge and with its characteristic aroma of kerosine and deep-throated roar, gave a neat crop-spraying demonstration with sharp turns at each end of an imaginary field to avoid imaginary trees.

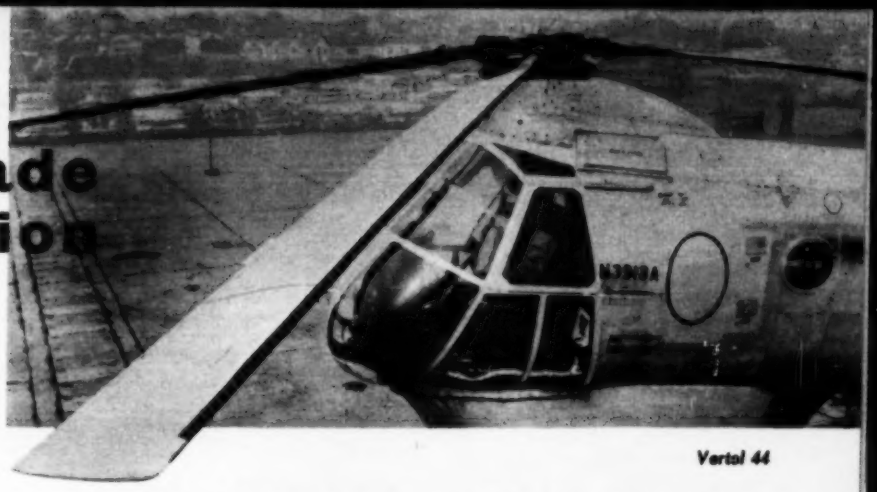
There was a splendid A.A.C. turn under Maj. R. Parker in a Skeeter, who first showed how well the chief instructor of the A.A.C. Centre handles his aircraft, then with two other Skeeters and an Alouette in train led some courtly formation dancing and "follow my leader" below tree-top height. This was quietly succeeded by a demonstration of models by Maj. F. G. Boreham; two Hillers acted as "targets" for spotters in a height-judging and type-identification contest; and a Widgeon piloted by Westland test pilot Leo Devigne air-lifted a Nobel 200 car weighing 800 lb. The Hillers sprayed imaginary crops, using pure water as their insecticide for this occasion; and the Kolibrie flew again—the least expensive machine (for its size) in the world, and the cheapest on view.

Then the Army with Maj. Leach as commentator staged an exciting setpiece in which two scout-cars engaged a "tank" and called on helicopters for assistance. These were a Skeeter flown by Capt. Sharpe of No. 651 Sqn. and Whirlwinds piloted by Maj. Warburton and S/L. Clark of J.E.H.U. There was a satisfying bang as the "tank" was destroyed, the Whirlwinds dropping reinforcements and at the end of the battle picking up casualties. To round off the rally there was a grand fly-past in which 13 aircraft participated, the Kolibrie coming by at ground-level aboard its trailer before taking the Duke (who had meanwhile had a Widgeon flight) back home. When all the formal flying was over, B.E.A. continued to serve a steady queue of customers.

Immediately below, left to right, the B.E.A. Whirlwind which did a brisk business in pleasure-trips; the Duke of Bedford alighting from the Hiller to open the display; and the European Helicopters' Kolibrie approaching its trailer. Bottom left, Alan Green of Bristow Helicopters disporting in the Widgeon; and right, one of the Skeeters and the Alouette at speed in the Army Air Corps "follow my leader" demonstration
"Flight" photographs

Rotor Blade Construction

A DESIGN NOTEBOOK OF BRITISH, AMERICAN AND CONTINENTAL PRACTICE



Vertol 44

HELICOPTER rotor blades offer as great a challenge to the engineer as any airframe component. Weight is critical, stiffness particularly important, protective finish essential and research and fatigue analysis most necessary. Much worthwhile development has been done in recent years and fatigue problems have been overcome to an extent where blade lives of 6,000 hr are now reasonably common and full interchangeability is possible. While the construction of wooden rotor blades is largely based on extensions of wing or propeller manufacturing techniques, unique methods have been developed for the production of metal rotor blades. Until recently, much of this information was secret, but in January Sikorsky work in this field was revealed in a lecture to the I.A.S. in New York, and last year Bell published information on its bonded metal blades. The experience of these companies has been drawn upon in compiling these notes.

Whatever constructional techniques are employed—and methods are legion—the same problems have first to be solved before detail design can begin. A basic parameter is blade disc diameter, because upon this will depend the amount of thrust that can be obtained for a given power, the relationship of disc to power loading (which determines the hovering performance and power available for climb) and, quite simply, the overall size of the machine.

A limit on blade diameter is set by the structure weight required to give sufficient static strength to the blade, and rotational speed is limited by the power available. Stalling of the retreating blade under conditions of high disc loading and high forward speed can be avoided by increasing rotational speed, but only up to the point where compressibility effects are encountered at the tips of the advancing blades. Other ways of delaying the stall of the retreating blade are to increase the solidity factor by increasing the number of blades or the blade width (structural factors set the practical limits) or to use negative blade twist.

Although "exotic" aerofoils with high lift characteristics have been used experimentally, close control of tolerances is necessary and the high control loads which may occur outweigh theoretical advantages over the more widely used symmetrical sections such as the NACA 0012 or 0015 series. Nevertheless, wind tunnel tests continue and some promising results—particularly at high Mach numbers—have been obtained.

The first Sikorsky metal blades consisted of an integral spar with web-like partitions faired by sheet metal trailing edge section and with reinforcing plates bonded to the root to take the localized stresses. Subsequently, an extruded spar was used with an upset end at the root, but fabricating difficulties were encountered and the full length of extruded spar is now machined to leave a heavy root attachment. The thickness of the machined metal is checked with ultrasonic test equipment and many production spar assemblies are fatigue tested. Individual pockets forming a segmented trailing edge are bonded to this extruded spar and the gap between adjacent pockets is sealed by resilient material fitted into the cavity formed by the ends of adjoining pockets. The pockets are thus sealed, but not rigidly fastened together.

Two particular advantages are claimed for this type of construction. Firstly the segments will resist the high transient edgewise loads along the trailing edge which tended to buckle the continuous-strip trailing edges of earlier metal blades, and secondly, the individual pockets can easily be removed for replacement or repair. This feature is also to be found on the blades of the Fairey Rotodyne, which, although almost entirely stainless steel, have an articulated trailing edge of aluminium alloy skin-rib boxes.

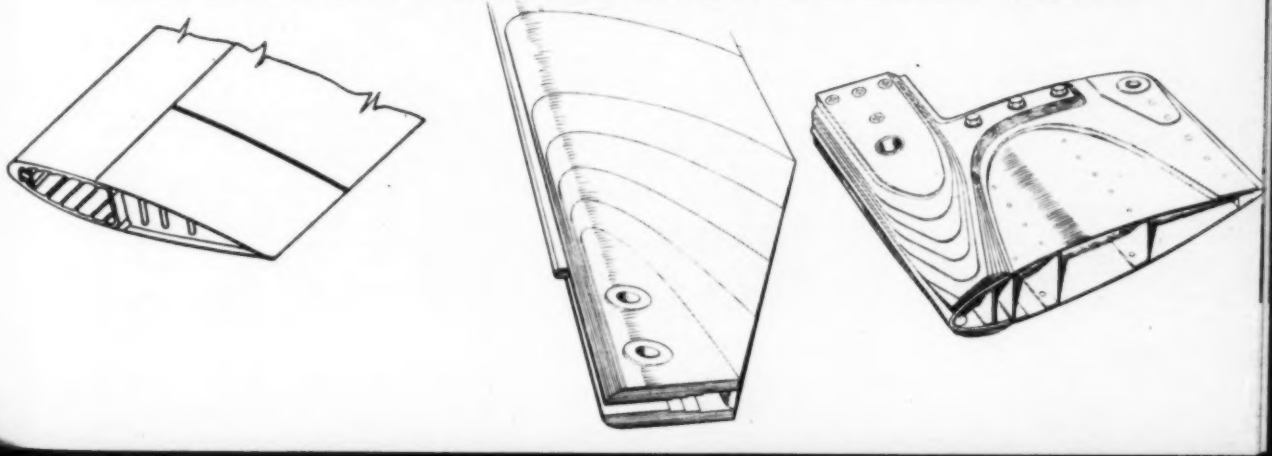
Sikorsky and Bell blades are fabricated principally in aluminium alloy. Sikorsky use 6061-T6 material for its good extrusion properties, good corrosion-resistance and low notch sensitivity, and they say that after many years of experience with this alloy there is no real advantage to be gained by changing to anything else, although titanium, steel, fibreglass and plastics have all been investigated.

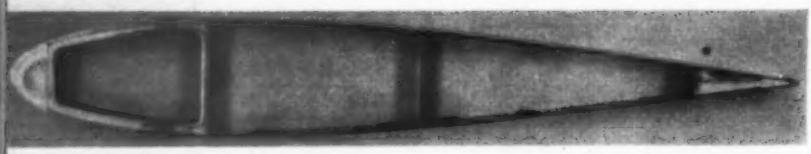
The basis of the Bell bonded metal blades is a heat-treated 2014-T6 aluminium alloy spar to which .020in thick sheets of stretcher-levelled 2024-T81 skins are attached—the latter are selected to preclude susceptibility to inter-granular corrosion and to give the best resistance to notch sensitivity. The nose block extrusion at the inboard end (see photograph on p. 678) is 2024-T6 aluminium alloy, but outboard hard drawn naval brass is used of nearly the same coefficient of expansion as the aluminium. The trailing edge is a continuous extrusion; to improve the forward mass balance in the tip area it is tapered from mid-span. The leading edge is sheathed in stainless steel.

On completion of all machining and cleaning operations the components of Bell blades are bonded together in an autoclave, a holding fixture preventing sagging and controlling the twist of the bonded blade. Rubber bags used within the blade, as well as outside it, maintain an even pressure on all the joints and allow heat and pressure to be applied simultaneously. In operation the autoclave is pressurized to 100 lb/sq in before heat is taken above 150 deg F, so that relative movement of the various components can take place while the adhesive softens. Final bonding temperature is 400 deg F.

After ultrasonic testing the finished bonded blade is neat, strong

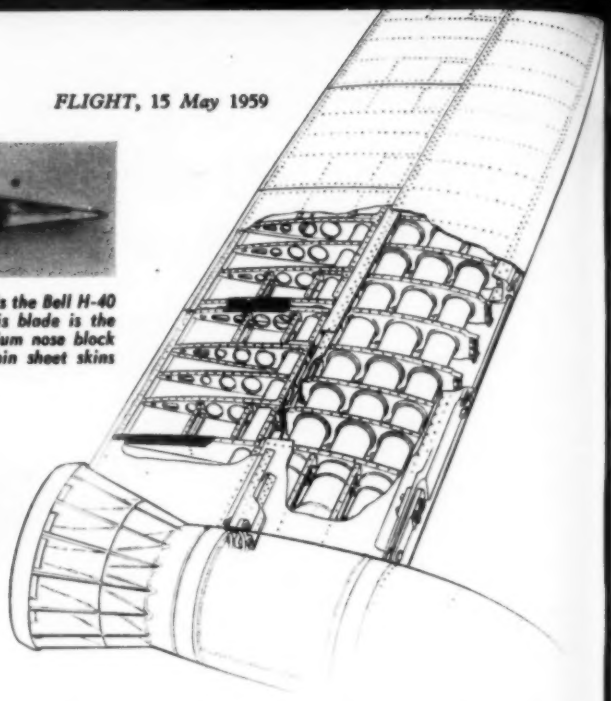
Three examples of bonded metal blades. Some 20,000 Sikorsky blades (left) have been built and millions of blade hours accumulated. The basis of the blade is an extruded aluminium alloy D-section nose, to which are attached individual trailing-edge sections. N.H.I. Kolibrie helicopter blades (centre) are stiffened by Redux-bonded plates where the root is attached to the laminated-spring hinges. Hiller blades (right) are similarly reinforced by a multitude of doublers; these blades are designed and built for Hiller by the Parsons Corporation





Bell are another advocate of all-bonded construction. The section shown is the Bell H-40 blade which has a chord width of about 15½in. The backbone of this blade is the extruded aluminium alloy spar. This is faced with a brass and aluminium nose block and a stainless steel leading edge; the light trailing edge section, thin sheet skins and I-spar are all aluminium alloy

Vertol blades are an assembly of individual light alloy boxes forming the trailing edge section bonded to a steel D-section spar. A C.A.A.-approved service life of 6,000 hr has been granted for these blades on the Vertol 44 and they are also used on H-21s. The manufacturers claim that they have a vibration level equal to or better than that of wooden blades in current operational use



Load-bearing portions of the Rotodyne blade are manufactured from steel. A machined D.T.D.730 front spar is slotted to carry an adjustable chordwise balance bar and the complete nose section is covered with 20 s.w.g. stainless steel skin. Aft of the rear spar construction is light alloy. Very light gauge material (28 s.w.g. ribs, 30 s.w.g. skins) is used and the trailing edge is Hycar foam rubber

Rotor Blade Construction . . .

and free from stress-raising bolt and rivet holes that limit fatigue life—even the root-end doublers are bonded in place; they are held in position before curing by spot-tacking with tape adhesive.

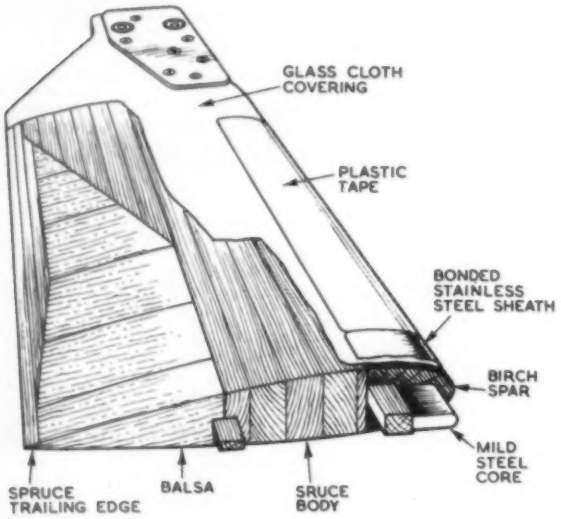
Sikorsky found that bonding the trailing-edge pockets to the spar was absolutely necessary to obtain good fatigue characteristics. A similar technique is adopted by Vertol, who bond a trailing-edge section fabricated from a series of aluminium boxes on to a D-section steel spar. The light alloy boxes, consisting of ribs and skins, are also assembled by bonding. All of these bonded blades have been cleared for service lives of 6,000 hr.

The rotor blades of the ramjet tip-drive Dutch Kolibrie are a variation of American practice. The nose section is a light alloy extrusion (through which are ducted the fuel and ignition lines to the tip ramjets) and this is bonded to Alclad sheets of U-shaped cross section to complete the profile. Surprisingly, there are no ribs and no filling in the trailing-edge section at all, although the blade is stiffened and thickened at the inner end by Redux-bonded covering sheets. In contrast, the big Rotodyne blades are riveted assemblies of steel spars, skins and pressed ribs, the use of stainless steel on the main load-bearing structure reducing susceptibility to fatigue. To complete the picture, the accompanying sketches show two methods of wooden blade construction, the bonded Hordern-Richmond blades for the Bell 47 being noteworthy for the number of different materials used. Blades for production Saunders-Roe P.531s are manufactured by the same firm and construction—a spruce spar sheathed in stainless steel with a spruce and balsa body—follows similar lines to the Bell blades. Prototype P.531 blades are based on Skeeter practice.

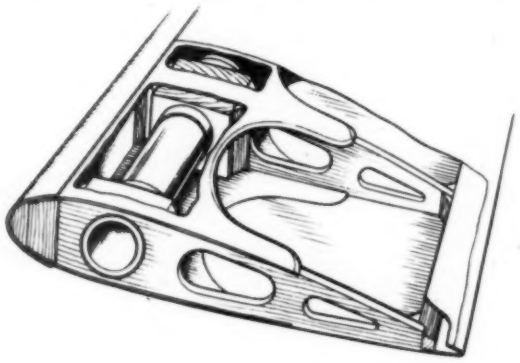
Before a new blade is ready for service, balancing and an extensive programme of fatigue tests must be carried out. Adjustable counterweights are used to balance the blade against a master and the weight is checked at three positions so that the centre of gravity of all blades is identical. Finally, static balancing is followed by aerodynamic balancing on a whirl-test stand.

As many as 200 blades may be subjected to fatigue tests to reduce the scatter of random results and a typical programme will involve strain-gauge testing both under laboratory conditions and later in flight so that results can be compared. Resonance testing ensures that the natural frequency does not coincide with a multiple of rotor r.p.m. and several thousand hours whirl-rig testing may be devoted to the development of a particular rotor head and set of blades.

Although a number of new methods are being employed in reducing design and development time, few short cuts are possible in the lengthy process of producing a new rotor. Computers help to reduce the time needed to resolve conflicting design parameters, and blade-mounted cameras have proved a useful flight-testing tool for measuring actual blade deflections. Perhaps the most promising next steps are new techniques for testing scale models of blades in a wind tunnel, where there are possibilities of forecasting accurately the stresses likely to be encountered. Such a method of eliminating trouble at a very early stage could reduce development time by months or years. A.T.P.



Two types of wooden construction. Left, Hordern-Richmond's composite birch-balsa blade used on the Bell 47. The root end fitting is bolted through the mild steel core that is used solely for mass balancing. The Saunders Roe Skeeter blade (right) is based on an Accles and Pollock steel-tube spar. Covering is madapollam, doped and painted



Helicopters of the World

A "Flight" Special Review of Current and Projected Types

GREAT BRITAIN

Bristol Aircraft Ltd.

Filton, Bristol.

Type 192 (Series 2) In current production for the Royal Air Force, the Type 192 (Series 2) is powered with two Napier Gazelle free-turbine engines and is suitable for communication, freight-carrying, ambulance work, paratroop or supply dropping, search and rescue, submarine search and ferry operations. It is one of a series of twin-rotor helicopters developed from the Type 173 (middle aircraft in the heading picture). The philosophy behind the twin-engined, twin-rotor formula, Bristol say, is the ability to continue operation even if one engine should fail. The transmission arrangement allows either engine to drive both rotors.

The fuselage section between the front engine compartment and the forward fin frame, which forms the main cabin, is of constant ovoid section and is 24ft 1in long, 5ft 3.25in wide and 4ft 11in high. Crew entrance is by doors either side; these have a full sized window and are jettisonable. The main entrance door is on the starboard side and is 50in wide by 54in high; this is jettisonable and is hinged at the top. It can be replaced by a canvas door or by a strengthened door with a winch and searchlight mounted on it for specialist rôles. On the starboard side at the rear of the cabin is an emergency exit door.

The transmission system is designed for a maximum mean engine power of 920 h.p. from each engine during normal twin-engined operation. The front gearbox and intermediate gearboxes are designed to permit a maximum of 1,650 h.p. to be transmitted to cater for the one-engine failure case. There are three main gearboxes. The front and rear rotor gearboxes, which carry the rotors, are tilted forward to avoid the necessity for a pronounced nose-down attitude of the helicopter in forward flight. An overall reduction of 12 : 1 is obtained in two stages of spur gears in the front rotor gearbox, and in one stage of spur gears and one of spiral bevel gears in the rear rotor gearbox. The latter is connected by the rear rotor shaft to the intermediate gearbox at the base of the fin.

A synchronizing shaft running at 1.2 times engine speed joins the intermediate gearbox to the front gearbox through the medium of spiral bevel gears. This shaft keeps the rotors in their proper phase relationship and permits both rotors to be driven by one engine in the event of an engine failure. It is supported by rubber mounted steady-bearings in a duct along the top of the fuselage.

The front engine is connected to the front rotor gearbox, and the rear engine to the intermediate gearbox, by couplings which allow for a small amount of misalignment between engines and gearboxes.

Heading picture: Napier Gazelle-powered Bristol Type 192 (Series 2) (foreground) in company with the Alvis-powered Type 173 and a Sycamore. Below is a Sycamore (Alvis Leonides)

The prototype Fairey Rotodyne as it is now flying, powered with two Napier Eland engines

Helicopters of the World . . .

In the input to each of these gearboxes there is a freewheel so that the rotors can over-run the engine in autorotation or single-engine flight.

The Type 192 has two four-blade rotors. The front rotor turns anti-clockwise and the rear one clockwise, viewed in plan. Initially wooden blades, of the type which have been employed in the 171 and 173 will be fitted to the 192. Under intensive development is a constant-chord light-alloy blade which will be offered as an alternative to the wooden blades.

The four-wheeled undercarriage is designed for a normal vertical landing velocity of 8ft/sec and an emergency landing velocity of 12ft/sec.

For communication work the Type 192 has seats for 18 passengers. These face inwards and are of the folding deckchair type. For short-range operations seating can be available for 22 or 25 persons. A scrambling net can be attached to the lower sill of the doorway.

In the freight rôle a maximum distributed load of 6,000 lb can be carried in the cabin, and particularly awkward loads can be slung externally from a strongpoint under the fuselage. For ambulance work there is accommodation for a medical attendant and eight stretcher cases in addition to pilot, co-pilot or navigator; twelve fully equipped paratroopers can be taken when the aircraft is used for assault missions. The search and rescue rôle calls for an electrically operated winch, and for submarine search a crew of three is carried, or possibly a fourth if it is necessary to operate the sonobuoy equipment for long periods.

● Rotor diam., 48ft 11in; overall length (with rotors), 87ft 1in; basic operational weight (with two crew and oil), 10,913 lb; max. all-up weight, 18,000 lb; max. speed, 138 m.p.h.; service ceiling, 13,250ft; hovering ceiling (without ground effect), 8,000ft.

Sycamore The basic Sycamore is a five-seater. In addition to the main cabin, which has a volume of 100 cu ft, it has a luggage compartment of 20 cu ft and is provided with all the fixed fittings needed to convert it to any of six major rôles, viz., search and rescue, air ambulance, passenger transport, freight transport, aerial crane and dual instruction. In addition to these primary capabilities, the Sycamore is suited to a variety of special tasks, and to equip it for any one of these, or to change it from one to another, is a simple operation. For all rôles the aircraft is normally equipped with three folding canvas seats for passengers and one seat beside the pilot.

● Rotor diam., 48ft 7in; overall length (blades folded), 45ft 2in; basic empty weight (passenger version), 4,130 lb; disposable load (passenger version), 1,270 lb; max speed, 124 m.p.h.; economical cruising speed, 88 m.p.h.; service ceiling at 5,400 lb, 15,500ft; hovering ceiling (without ground effect) at 5,400 lb, 4,000ft.

Fairey Aviation Ltd.

Hayes, Middx.

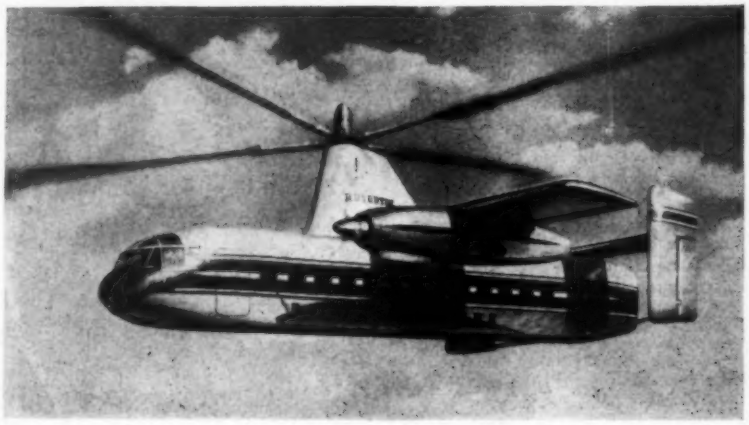
Rotodyne The Rotodyne is perhaps the most remarkable, and certainly one of the most promising, of all the world's rotary-wing aircraft. A summary of the design philosophy, construction, flying procedures, and test and development programme formed the subject of a lecture by Dr. G. S. Hislop delivered late last year and reported in *Flight* of November 14. Our report concluded with this quotation from Dr. Hislop's address: "At the moment, I would not care to say that higher speeds than 220 kt cruise could be achieved, though experience is a great teacher. In any case, an economic VTOL aircraft, with adequate performance standards with an engine failed, *and* a cruising speed of 220 kt, with all-weather capabilities is, I am certain, a vehicle which no operator, civil or military, scheduled or bush, can possibly afford to ignore."

Developments of the greatest importance have since been announced, notably that New York Airways have completed negotiations with Fairey regarding the supply initially of five Rotodynes, with an option on a further 15.

The version of Rotodyne ordered by New York Airways is larger, faster and more powerful than the 48-seater prototype now flying. It will be powered by two Rolls-Royce Tyne engines and will carry 57 passengers or 15,000 lb of freight at a speed of more than 200 m.p.h. over a 250-mile stage (i.e., London to Paris) with full allowances. Maximum passenger load will be 65 (or 18,000 lb of freight) over 120 miles; range will be 650 miles.

The Rolls-Royce Tyne engines will each deliver some 5,000 s.h.p. Announcing the New York Airways order the Fairey company remarked, "Research and development on the suppression of noise from the

An impression of the enlarged Rolls-Royce Tyne-powered Rotodyne, described in the text



tip-jets at take-off is proceeding successfully. In forward flight, with the tip-jets closed down, the Rotodyne is rather quieter than a Viscount . . ."

By the beginning of March this year the Rotodyne prototype had completed 174 flights, 210 transitions and 63 flying hours. The makers reported:—

"The high-light of the flying to date has undoubtedly been the high cruising speeds attained. The Rotodyne has already flown at speeds of up to 200 m.p.h. and these are being steadily increased as flight testing proceeds. A striking demonstration of this was given when the Rotodyne set up (subject to confirmation by the F.A.I.) a 100 km. closed circuit record of 191 m.p.h. last January. This exceeds the previous *absolute* speed record for helicopters by 29 m.p.h. and the 100 km. record by 49 m.p.h. Other significant features of the flight test programme are: (a) The transition between tip jet powered and autogyro flight has proved simple and straightforward. It has been carried out on many occasions at altitudes as low as 200ft even under instrument conditions. The transition involves no change of flight path and is imperceptible to passengers. The transition has frequently been completed within 45 sec of take-off. (b) Vibration level is low. (c) The tip-jet performance and reliability are excellent. (d) Intensive instrumentation, including 15,000 yd of 35 mm film and some 95,000 yd of continuous trace recording, has shown fatigue stresses in the head and blades to be low. This, combined with the all-steel construction, will give long component lives. (e) Some of the flights have been in conditions of extreme turbulence and heavy rain when the pilot was compelled to fly on instruments for significant periods. On occasions the weather limits have been as low as 100ft cloud base with 300ft visibility. There is no doubt that the prototype Rotodyne has been extremely successful; all of the design aims have been achieved; the basic soundness of the design has been proved."

The principle of the Rotodyne is now well known. Briefly, the powerplant (two Napier Elands in the prototype) is engineered to feed compressed fresh air to the main rotor for vertical flight; most of the Eland's power is absorbed at take-off by the rotor, the tip of each of which is fitted with a kerosine-burning pressure jet. Transition to forward flight is achieved by progressively transferring power from the rotor to the propellers. In this condition the Rotodyne cruises solely on the thrust of the propellers, lift being provided by the autorotating rotor and the conventional wing, the last-named component providing about 60 per cent of the lift during the cruise. Data are for the Tyne version.

● Rotor diam., 104ft; fuselage length, 64ft 6in; overall height, 23ft 2in; gross weight, 50,000 lb; cruising speed, over 200 m.p.h.; typical stage length, 250 miles.

Saunders-Roe P.531s (Blackburn Turmo 600)

Saunders-Roe Ltd.

Osborne, East Cowes, I.o.W.

P.531 In *Flight* of March 20 last it was announced that a pre-production contract for the P.531 had been placed by the Ministry of Supply on behalf of the Royal Navy.

The P.531 has been designed as a compact turbine-powered general-purpose helicopter, and the makers' design philosophy is summarized as follows: "A lightweight powerplant of simple design and robust construction was required, and the Blackburn Turmo 600 Series free turbine engine was chosen as the unit most suitable for the purpose. The free turbine eliminates the necessity for a clutch in the aircraft transmission, there is no warming-up period and the engine will operate on commercial fuels such as low octane petrol, kerosine, or light diesel fuel. The four-bladed main rotor gives low vibration levels and control forces at the high forward speed and altitudes at which the helicopter will be called upon to perform. The wealth of experience gained from the development of the Skeeter has been embodied in the P.531. The airframe and transmission have been designed to accept a power unit of much higher output than the one selected. With the more powerful engines now under development the aircraft will be capable of operating with higher payloads."

The structure is all-metal and the cabin seating arrangement is two single seats at the front and, behind these, a single bench-type seat for three passengers.

The makers list the operational rôles as liaison, casualty evacuation, reconnaissance, air/sea-rescue, weapon carrier, light freighter, and trainer. Of its capabilities as a weapon carrier they say, "The manœuvrability, small target size, and low noise level make it an admirable weapon for attacks on tanks, supply lines, submarines, etc. The aircraft has ample ground clearance under the fuselage for the carriage of a variety of weapons. A rocket battery with a small gun to fire tracer for sighting can be fitted for use against entrenched positions or, alternatively, an anti-tank armoury of wire-controlled guided missiles. Two homing torpedoes can be carried beneath the fuselage for use against submarines."

● Rotor diam., 32ft 6in; overall length (blades (folded), 29ft; weight empty, 2,077 lb; gross weight, 3,800 lb; cruising speed, 115 m.p.h.; max. speed, 121 m.p.h.; max. range (normal tankage), 210 nautical miles.

The initial—"crane-transporter"—version of the Westland Westminster (two Napier Elands)

A Westland Wessex of the Royal Navy, powered with a Napier Gazelle

Westland Aircraft Ltd.

Yeovil, Somerset.

Westminster The Westminster has been built in the first instance as a "crane-transporter" and is now undergoing weight-lifting trials. It is the largest twin-turbine mechanically driven single-rotor helicopter in the Western world, and it is claimed that it is able to operate with full payload on one of its Napier Eland engines if need be. Discussing lifting technique Westland say:

"The design of the crane-transporter version provides for the carriage of loads externally, although it is possible to dispose internally as well where shape and size permits. The fuselage structure could be modified to introduce rear-loading facilities should this be particularly desirable for certain rôles. However, investigations of the various methods of carrying loads have shown that for crane duties and for many transportation duties over distances up to 100 miles freight and equipment is best carried externally. The increased flexibility of unrestricted load sizes and shapes, and the rapidity of external loading and unloading, combined with the possibility of jettisoning the load in an emergency, are obvious advantages . . . Moreover, by this method loads can be ferried into and out of locations where it is not convenient or possible for the helicopter to land. A single load anchorage point has therefore been built into the base of the fuselage structure for securing a sling mechanism, and a hoist is provided to wind in the excess cable length after the load has been attached . . ."

They add that with its disposable load of some 14,000 lb the aircraft meets the requirement for a large military transport able to carry heavy field equipment, tactical and nuclear weapons and troops over stages of 150 miles or more. Typical loads could be 51 troops, five missiles or four jeeps.

The structure is in four sections: cockpit; main fuselage welded structure; tail pylon; and main rotor pylon support structure. The two Elands are mounted side by side ahead of the main gearbox on top of the fuselage. A shaft from each engine drives an oil cooler fan beneath each engine. To these fans are bolted the engine oil coolers which are mounted on a separate structure which also cradles the fuel header tank.

A civil version is projected, capable of carrying 45 passengers or 7,650 lb of freight over stage lengths of 200 miles, at 150 m.p.h. The data apply to the crane-transporter version with two Eland NEl.6s.

● Rotor diam., 72ft; fuselage length, 71ft 4in; basic weight, 21,600 lb; normal gross weight, 36,000 lb; cruising speed, 115 m.p.h.; max. range, 180 nautical miles; rate of climb on two engines at 75 kt, 1,900ft/min; hovering ceiling (10ft wheel clearance), 9,000ft.

Wessex The makers regard the Wessex as the logical complement of the Whirlwind, meeting the requirement of greater lifting capacity and cabin volume. It was developed by the company from the piston-engined Sikorsky S-58 and is claimed to be the first large turbine-powered helicopter in full production in any country. The type has been adopted by the Royal Navy as its standard anti-submarine aircraft, and readily combines the rôles of search and strike, carrying sonar equipment and weapons, and fully automatic devices that enable it to operate by day or night in all weather, either from carriers or shore bases. As a transport 16 fully equipped troops can be lifted over short stages, i.e., between off-shore carrier anchorages and battle areas. A civil version could take 12 passengers in comfort.

Light-alloy monocoque construction is used throughout. The main rotor head is four bladed and rotor movement is controlled by fully duplicated servos. Since the engine—a Napier Gazelle NGa.13—is of free-turbine type, the conventional clutch has been dispensed with and the engine drive is direct to the main gearbox.

For civil work the standard seating would be arranged with the front three seats facing aft and a bank of six seats in three pairs facing forwards. The remaining three seats would be side by side at the rear of the cabin.

● Rotor diam., 56ft 7in; fuselage length (tail folded), 38ft 4in; equipped weight, 7,600 lb; gross weight, 12,600 lb; max. speed, 144 m.p.h.; economic cruising speed, 115 m.p.h.; vertical rate of climb at s.l., 600ft/min; hovering ceiling with ground effect (1 hr power), 7,000ft.

Whirlwind The Whirlwind continues in production and is offered with the Alvis Leonides Major, Pratt and Whitney R-1340 or Wright R-1300 piston engine. A recent version is the Mk 7 developed specifically for anti-submarine duties with the Royal Navy and carrying a homing weapon or sonar gear as special equipment. The engine is mounted in the nose and is readily accessible by opening two clamshell doors. The all-metal main rotor blades can be folded to minimize storage space. Data below apply to a passenger version with Leonides Major 755 engine.

● Rotor diam., 53ft; fuselage length, 42ft; equipped weight, 5,375 lb; normal gross weight, 7,800 lb; max. cruising speed, 99 m.p.h.

Widgeon The Widgeon is a general-purpose five-seat helicopter developed from the four-seater Dragonfly (S-51). The engine is the Alvis Leonides 521/2 and the aircraft is offered for the following

[*Continued on page 683*]

Above, a civil Westland Whirlwind (Alvis Leonides Major); below, a Widgeon (Alvis Leonides)

duties: public transport with pilot, four passengers and luggage; pilot training with side-by-side seating and full dual control; ambulance, carrying two stretchers internally and medical attendant; search and rescue, using detachable hydraulically operated winch capable of lifting two people simultaneously; freight transport with jettisonable sling for external loads of 1,000 lb; spraying and dusting for pest control and crop culture; anti-submarine detection, using detachable pack unit containing sonar gear; police and coastguard patrol, using loud-hailer unit; and water-borne operations using floats.

● Rotor diam., 49ft; fuselage length, 41ft; empty weight, 4,322 lb; gross weight, 5,900 lb; economic cruising speed, 80 m.p.h.; hovering ceiling with 10ft wheel clearance in ground effect, 6,170ft; range at economic cruising speed with standard tanks, 260 n.m.

BRAZIL

Centro Tecnico da Aeronautica

São Jose dos Campos.

Beija-Flor From 1952 onwards, the German Prof. Henrich Focke and his team worked in Brazil on the design and production of a light helicopter within the capabilities of the Brazilian industry. The Beija-Flor, as it is called, has now made its first flights after 40 hr of tethered tests. Power is provided by a fan-cooled Continental 225 h.p. engine mounted horizontally in the nose, driving the rotor through a centrifugal clutch, lorry back axle adapted for reduction and a freewheel. The rotor has only flapping hinges at the head, drag freedom being incorporated in articulations at mid-blade span. Cyclic-pitch variation is used only for lateral displacement. Two intermeshing, three-bladed tail rotors serve for longitudinal control by collective-pitch variation from the stick and for directional control by differential-pitch variation from the rudder pedals. The machine was designed to U.S. airworthiness specifications.

● Rotor diam., 29ft 7in; length, 28ft 11in; gross weight, 2,260 lb; disposable load (two occupants), 652 lb; max. cruising speed, 87 m.p.h.; vertical climb, 197ft/min; ceiling, 12,200ft.

Omnipol HC-2 Heli-Baby

CZECHOSLOVAKIA

Omnipol Ltd.

Washingtonova 11, Prague III.

HC-2 Heli-Baby An indigenous Czechoslovak design, the Heli-Baby is one of the lightest two-seat helicopters in the world. With a three-bladed, fully articulated rotor and dual controls, it is powered by a Praga DH flat-four piston engine giving 83 h.p. at 3,000 r.p.m.

Low operating costs, sturdy construction and sensitive and responsive controls are claimed to make the Heli-Baby suitable for training as well as for a wide range of utility applications, including patrol, transport and liaison work. Practice engine-off landings can be made without switching off the engine. Very low vibration and noise level and excellent visibility from the covered cabin are further favourable features. The standard undercarriage consists of main- and nosewheels and the engine is mounted behind the cabin, with its crankshaft inclined to the vertical. A metal monocoque boom carries the tail-rotor transmission, tail rotor, trimming surface and tail bumper.

In one hour the Heli-Baby can carry a pilot and 220 lb of payload over 62 miles, using only 4.85 gal of fuel. The rotor blades can be rapidly dismantled for simple transport by road or rail over long distances. The whole machine can be inspected and serviced from ground level.

● Rotor diam., 28ft 11in; length, 34ft 5in; empty weight, 840 lb; gross weight, 1,280 lb; hovering ceiling, with ground effect, 3,600ft; rate of climb, 710ft/min; max. speed, 78 m.p.h.; cruising speed, 62 m.p.h; range, 93 miles.

FRANCE

Sud-Aviation S.N.C.A.

37 Boulevard de Montmorency, Paris 16.

SA.3200 Flight trials of this latest and largest helicopter to come from the Sud factory at La Courneuve should now be under way. Although designed to a joint French Air Force, Navy and Army specification, civil requirements have been kept in mind and it should be capable of carrying 25 or more passengers. It is powered by three Turboméca Turmo III free-shaft engines, giving 800 h.p. each, all geared to a single primary pinion which in turn drives the rotor through a reduction gear. The four blades of the tail rotor are twisted like those of a propeller. Fully powered hydraulic control is provided, together with a SFENA 351 yaw and roll damper using rate gyros. Two hydraulic pumps and an oil cooler are driven by the transmission. All fuel is carried in streamlined tanks mounted on outriggers, the rear supports

Sud SA.3200

Above, Sud SE.3160 Alouette III. Below, Sud SE.3130 Alouette II

Helicopters of the World . . .

of which also carry the fixed main wheels of the nosewheel undercarriage. The machine stands high enough off the ground to facilitate the loading of external stores.

The crew of two sit in the nose and have separate access doors, while two large doors and an escape hatch provide access to the main cabin. The complete tail unit hinges sideways to allow direct loading of vehicles. A trimming tailplane is set to ride up to the flight position under airloads, but is depressed by a spring to a vertical position during hovering. Cowling panels around the transmission, the two Turmos forward and one aft fold down to form a continuous walkway for servicing.

Three starters and three throttles are used to run the engines up to operating speed separately, after which a single twist-grip on the collective-pitch stick controls combined power, the throttle levers then serving to synchronize the engines.

For military use, the 3200 can carry 24 soldiers or eleven stretchers and it can be used for such purposes as towing boats.

● Rotor diam., 49ft 2in; length, 47ft 6in; empty weight, 9,920 lb; gross weight (civil), 15,630 lb; max. gross weight, 17,600 lb; max. speed, 168 m.p.h.; cruising speed, 150 m.p.h.; ceiling, 9,850ft; endurance, hovering out of ground effect, 3.5 hr.

SE.3160 Alouette III Following development of the basic Alouette II formula, using the more powerful Artouste III (550-600 h.p.) and, in another experiment, a Turmo free-turbine engine, the final Alouette III configuration has now been revealed. The Gouverneur executive helicopter has now been dropped. Though at present powered by an Artouste III, production versions will have a Bastan derated to 450 h.p. The standard Alouette transmission is retained, but rotor diameter has been increased and the number of tail-rotor blades increased to three. The tail is now a monocoque and a streamlined cabin has been arranged for two pilots and a passenger in front and a four-seat bench behind. Side doors both slide and hinge upwards. A nosewheel undercarriage is fitted. The standard Alouette II fuel tank leaves room on either side for freight or even for personnel sitting facing outwards.

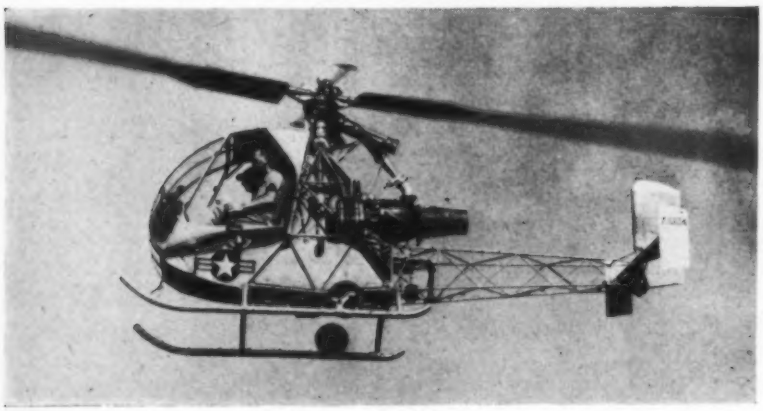
● Rotor diam., 36ft; length, 32ft 10in; empty weight, 2,290 lb; max. gross weight, 4,620 lb; max. speed 124 m.p.h.; cruising speed, 113 m.p.h.; hovering ceiling, with ground effect, 12,250ft; range, 335 miles.

SE.3130 Alouette II Following the recent order for 130 Alouettes placed for the German Army, the total number of Alouettes ordered has risen to more than 400, of which more than 300 have already been delivered. The type has in fact achieved outstanding success and gained many records, particularly for altitude, time to height and landing at height. It is in civil and military service in many parts of the world and licences for production have been taken by Republic Aviation Corp. in the U.S. and Saab in Sweden.

As well as performing all manner of tasks as a five-seat utility, the Alouette has been used for dropping homing torpedoes and for firing Nord SS-10 and SS-11 wire-guided missiles. It is powered by a Turboméca Artouste II, giving 360 h.p., directly driving the rotor through a reduction gear. The collective-pitch lever controls a constant-speed governor and no actual throttle movements are required in flight.

● Rotor diam., 33ft 6in; length, 31ft 10in; empty weight, 1,870 lb; gross weight, 3,300 lb; max. speed, 111 m.p.h.; cruising speed, 107 m.p.h.; hovering ceiling with ground effect, 10,200ft; service ceiling, 13,800ft; range at s.l., 330 miles.

Sud SO.1221 Djinn



SO.1221 Djinn More than 150 of these light two-seat utility helicopters have now been ordered and most of them completed. Power is provided by a Turboméca Palouste air generator delivering compressed air to nozzles at the tips of the two-bladed main rotor. Directional control is ensured by an aerodynamic rudder set in the jet efflux. Many rôles are possible, including crop-spraying and the carriage of two injured people in stretchers mounted alongside the fuselage. It is reported that a "Super Djinn" is being prepared, powered by the more powerful Palouste IV.

● Rotor diam., 36ft 2in; length, 17ft 4in; empty weight, 794 lb; gross weight, 1,676 lb (civil) and 1,764 lb (military); max. speed, 81 m.p.h.; cruising speed, 62 m.p.h.; max. range 112 miles; during successful record attempts, a Djinn has reached more than 27,000ft.

Borgward BFK.1 Kolibri

GERMANY

Carl F. W. Borgward G.M.B.H.

Bremen-Sebaldsbrück, Bremen 11.

Kolibri I The first all-German helicopter to fly since World War 2, the Kolibri I was designed by a team led by Prof. Dr. Ing. Henrich Focke, who spent many post-war years working in Brazil. The machine, called BFK.1, is flying from the makers' helicopter field in Bremen and the first series of tests is complete. The second machine, which will be the first to have an enclosed fuselage, is almost ready to fly and preparations for production are in hand.

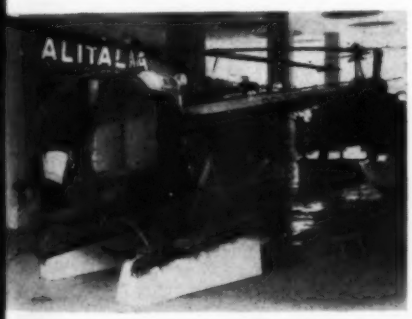
Borgward have produced this helicopter as a private venture and great efforts have been made by the German equipment industry to produce the special equipment and components.

The Kolibri has a steel-tube airframe housing a three-seat cabin forward, powerplant amidships with metal skinning. The tail boom is fabric-covered. Power for the three bladed main rotor and twin tail rotors is provided by a Lycoming VO-435-A engine, giving 260 h.p., driving the main rotor through a two-stage 10 : 1 reduction. The conical housing for the main vertical shaft also forms the transmission-oil tank and further drives are taken for the tail rotors, engine-cooling fan and a series of oil pumps for lubrication and hydraulic power. Engine oil is used in the hydraulic system.

Chrome molybdenum spars and plywood structure, covered with a special weather-resistant paint form the main-rotor blades. Drag and flapping hinges are provided, with friction dampers for the former. No controls are mounted on the hub itself, but there is a hydraulic stabilizing device which holds resultant forces within the axis of rotation, regardless of speed and direction of helicopter movement. Two three-bladed rotors at the tail are mounted at 90 deg to each other and controlled in such a way that they provide both longitudinal and yawing control. Moving aerodynamic surfaces are mounted on their shafts, so that aerodynamic control is available in forward flight should the mechanical drive fail. Cables controlled by the conventional control column and rudder pedals in the cockpit lead to a mixer box mounted aft of the engine. Correct co-ordination is thereby achieved and rotor torque is compensated without requiring rudder-pedal movements. The collective-pitch lever may be left alone when no change in flight path is required.

A 35 Imp. gal fuel tank is mounted aft of the transmission to form part of the external contour of the fuselage. Small, inflatable mainwheels are mounted on tapered tubes anchored to torsion rods in the fuselage. Additional damper struts have since been added. The castoring nosewheel has rubber-in-compression springing.

● Rotor diam., 29ft 7in; length, 28ft 5in; equipped weight, 1,720 lb; useful load, including 33 lb baggage, 770 lb; gross weight, 2,490 lb; max. speed, 100 m.p.h.; cruising speed, 87 m.p.h.; best rate of climb, 790ft/min; hovering ceiling in ground effect, 4,940ft.



Above, Agusta Model 103B

Below, Agusta Model 102

ITALY

Aer Lualdi

95 Via Panama, Rome.

L.57 A prototype of this light two-seater began flight trials last year. The company acquired the licence for the Hiller Rotormatic stabilizing system using two aerofoil paddles at right angles to the rotor blades. Since then they have developed a similar device of their own. Other special features of this machine are the subject of Lualdi patents. Originally conceived with a very small opposed-piston engine and designated L.55, the L.57 has been flying with a Lycoming O-360, giving 180 h.p., mounted low down in the nose ahead of the cockpit. The main rotor transmission passes through the fully enclosed cabin and a small tail rotor is carried on a stressed-skin boom.

● Rotor diam., 32ft 10in; overall length, 39ft; empty weight, 1,320 lb; gross weight, 2,200 lb; max. speed, 95 m.p.h.; cruising speed, 81 m.p.h.; rate of climb, 820ft/min; absolute ceiling, 13,200ft; endurance, 3 hr.

L.59 It is reported that the Italian army has placed an order for two prototypes of a four-seat helicopter under the above designation, powered by a Continental IO-470-D direct-injection engine giving 260 h.p. It is hoped that one of these will appear at the Paris Salon next month and a production batch of 50 is to be begun next September. No further details available.

Costruzioni Aeronautiche Giovanni Agusta

Cascina Costa, Gallarate.

Model 103 A new light two-seat helicopter with the designation model 103B was shown at the recent Milan trade fair. It is reported that a single-seat model, designated 103, is being prepared and might appear at the Paris Salon next month.

The 103B is powered by an Agusta GA.70V opposed engine giving 85 h.p. and mounted vertically immediately behind the occupants. The cabin is fully enclosed by moulded plastic panels and side-doors and the pilot's controls are on the right. The two-bladed rotor is of very simple design and the fuel tank forms the fuselage contour immediately beneath the rotor head. A tail boom formed from sheet metal with external stiffening is braced by two steel tubes and carries the tail-rotor shaft support bearings. Skid landing gear is fitted.

● Empty weight, 583 lb; gross weight, 1,055 lb; cruising speed, 75 m.p.h.; service ceiling, 11,800ft; range 156 miles. No further details available.

Model 102 This machine made its first flight during February. It is in fact a redesigned version of the unsuccessful Bell 48 of some years ago and the Italian company has virtually redesigned it. It is now powered by a Pratt & Whitney R-1340, giving 600 h.p., specially modified and certificated for this machine. The traditional Bell two-blade rotor with stabilizer bar is retained and, although the exterior dimensions have been reduced to a minimum, the cabin can accommodate two pilots (or a pilot and passenger) in front, up to three passengers in removable seats immediately behind them and five more people on a single, fixed bench aft. The tail-rotor is two-bladed and a horizontal stabilizer surface is fitted.

● Rotor diam., unknown; length, 41ft 9in; empty weight, 4,095 lb; gross weight, 6,200 lb; useful load, 2,310 lb; max. speed, 120 m.p.h.; cruising speed, 100 m.p.h.; hovering ceiling in ground effect, 9,200ft; max. range, 285 miles.

Fiat 7002

Helicopters of the World . . .

Licence production Under licence from Bell Helicopter Corp., Agusta have during recent years built about 300 Bell 47Gs and well over 30 47J Rangers for both civil and military customers. On their own account, Agusta have also produced five-seat and dual-control versions of the Ranger.

Transport helicopter Agusta are known to be working on the design of a 25-passenger helicopter, probably to be powered by three Turboméca Turmo 3 free-turbine engines. Details are being withheld pending completion of the design.

Fiat Divisione Aviazione

Corso Giovanni Agnelli 200, Turin.

Type 7002 Construction of the first prototype of this interesting machine is far advanced at Turin. It is to be a seven-seat, multi-purpose helicopter with a two-bladed rotor driven by cold tip-jets supplied with air by a centrifugal compressor driven by a free-turbine engine. Fiat claim that such an arrangement allows the choice of the proper value for the compression ratio corresponding to the best pneumatic transmission efficiency. Every effort has been made to simplify the structure and make it easy to maintain. Absence of clutch, reduction gearing and drive shafts make for simplicity; and the lightness of the system allows the best ratio of empty weight to useful or payload. Maintenance, operating and first costs are reduced while reliability and overhaul life are improved.

A small, ducted tail rotor ensures directional control at low forward speeds and during autorotation. Spar and leading edge of the main-rotor blades are made from welded stainless-steel sheets and include ducts for compressed air. The hub is of the tilting type, the two blades being joined by steel strips which absorb centrifugal loads while allowing pitch changes. The pilot is accommodated in the forward fuselage, with the load beneath the rotor head. Engine compartment and tail boom form the rear section. A 113 Imp. gal fuel tank is mounted above the main cabin, beneath the rotor head. Variable loads are therefore always located close to the c.g. Skid landing gear is fitted. The engine is the Fiat 4700 giving 500 gas h.p., the power section of which is almost identical with the Fiat 4002 turbojet.

Alternative loads include pilot and six passengers: pilot, attendant and two stretchers, with two more stretchers externally mounted; one pilot and 124 cu ft of freight. Other rôles, both civil and military, are foreseen.

● Rotor diam., 39ft 5in; length, 20ft 4in; empty weight, 1,320 lb; gross weight, 3,090 lb; max. speed, 106 m.p.h.; cruising speed, 84 m.p.h.; service ceiling, 11,150ft; range, 188 miles.

NETHERLANDS

Nederlandse Helicopter Industrie N.V.

Luchthaven, Rotterdam.

H-3 Kolibrie Production of this remarkable two-seat utility helicopter is now under way in Holland, with Kromhout making the ramjet engines, Aviolanda the fuselages and Fokker the bonded rotor blades. Assembly and testing are done by N.H.I. at Rotterdam. The Kolibrie's two-bladed rotor is driven by two N.H.I. TJ-5 ramjets giving about 60 h.p. each and weighing 20 lb. The blades are attached to the rotor head by a sheaf of steel leaf springs, both cyclic and collective pitch being changed by two torsion rods controlled through a single swash-plate. Cockpit controls are conventional. A small, single-bladed tail rotor provides directional control. To the very small airframe are attached the various items of equipment required for various rôles, including spraying, seeding, ambulance work, observation, training and transport. For starting, the rotor can be spun-up to self-sustaining r.p.m. either by a small petrol engine mounted on the main frame and driving the tail-rotor shaft through a belt, or by an external drive. A further petrol engine is mounted on the port frame to drive the pump for spraying liquid, in which rôle a long flexible spray-boom can quickly be attached. Skid or float landing gear can be provided, together with dolley wheels for ground-handling. Normally, the Kolibrie operates entirely from a flat-bed trailer towed by a field car. Four cylindrical tanks slung beneath the frame can carry kerosine fuel, or spray liquid when required for agricultural flying.

Handling characteristics are remarkably good, since the low disc loading and very high rotor inertia allow an ample margin for jump take-off or use in emergencies. It is almost impossible to flame-out the engines by mishandling, but should one fail, a single engined landing at a moderate initial rate of descent can be made down to ground level, where rotor inertia will amply suffice for brief hovering. With both engines flamed out, the rate of descent is considerable, but again inertia will allow effective round-out. Engines can be removed simply by unfastening two bolts. Fuel and ignition connections are automatic.

During demonstrations in Holland and Britain last year, the Kolibrie showed outstanding manoeuvrability and controllability. Because it is small and light, it is also cheap and costs about half as much as other helicopters with the same useful load. Average fuel consumption is from 40 to 50 Imp. gal/hr.

● Rotor diam., 33ft; length, 13ft 10in; minimum empty weight, 330 lb; useful load 904 lb; gross weight, 1,434 lb; normal rotor r.p.m., 400; total tank capacity, 88 Imp. gal; max. speed, 70 m.p.h.; cruising speed, 62 m.p.h.; best climb, 800ft/min; endurance, 1 hr.

POLAND

Motolmport

Przemyslowa 26, Warsaw.

SM-1 This is the Polish version of the Russian Mi-1 and is built in the PZL factory at Swidnik. Power is provided by a Russian 575 h.p. AI-26W seven-cylinder radial engine. The pilot sits alone in the front of the cabin and either two or three passengers are accommodated on a bench seat behind him. The machine has been adapted for rescue, ambulance and agricultural duties and is capable of operating under arctic conditions. For this purpose a fluid de-icing system is provided for the rotors and the windscreen can also be de-iced by fluid spread over the glass by the wiper. Engine oil may be diluted to facilitate starting in extreme cold. The inside of the windscreen can also be heated by hot air. De-icing fluid is contained in a 6 Imp. gal tank with a secondary supply in a tank holding 0.6 Imp. gal. A Polish-built SM-1 was shown at the 1957 Paris Salon.

● Rotor diam., 47ft; length, 40ft 9in; gross weight, 4,950 lb; empty weight, 3,927 lb; max. speed at s.l., 124 m.p.h.; max. vertical rate of climb, 1,280ft/min; hovering ceiling, 9,840ft; max. range at 87 m.p.h., 240 miles.

N.H.I. Kolibrie H-3

Above, Mi-6. Below, Kamov Ka-18

U.S.S.R.

Kamov

Ka-15 This is a two-seat helicopter with an AI-14R engine of 255 h.p. which drives co-axial rotors. The rotors are largely of wooden construction, but the fuselage is mainly metal. Ka-15s have been allotted to State Collective Farms for agricultural purposes and some fishing vessels are thought to have been provided with helicopters of the type.

● Rotor diam., 32ft 8in; cruising speed, 75 m.p.h.; hovering ceiling, 2,200ft; service ceiling, 9,800ft.

Ka-18 The Ka-18 is a development of the Ka-15 having a lengthened and redesigned forward fuselage with a cabin accommodating four persons instead of two. It is used for mail and freight carrying and geographic survey as well as for communications and ambulance work. Each of the co-axial rotor blades can be detached by two people in five minutes. The structure is a welded steel tube truss with a monocoque tail boom; the fuselage is dural skinned.

● Rotor diam., 32ft 7in; length, 23ft; empty weight (with V.H.F. radio), 2,255 lb; gross weight, 2,889 lb; max. speed, 93 m.p.h.; cruising speed at 1,600ft, 68 m.p.h.; max. range with 39 Imp. gal, 248 miles; range with auxiliary tanks, 435 miles.

Mikhail Mil

Mi-1 In all essentials the description of the SM-1 under "Poland" applies to this Soviet helicopter. The engine is an AI-26W of 575 take-off h.p. The passenger version has 3-4 seats and the agricultural version carries about 880 lb of chemicals in tanks one on each side of the fuselage. For ambulance duties panniers for stretcher cases can be similarly disposed. In the mail-carrying rôle also auxiliary panniers are used.

Mi-3 This type is distinguished from the Mi-1 by its four-blade rotor. There are also fuselage modifications, and the gross weight and disposable load are rather higher.

Mi-4 The characteristics of this very successful Soviet helicopter are seen in the large photograph on page 688. Several variants are in operation. The normal military model can accommodate the Soviet equivalent of the jeep, a small car, a 75 mm anti-tank gun, or two motor-cycle sidecar combinations. Fourteen armed soldiers are another possible load.

The variant used by Aeroflot is known as the Mi-4P and seats ten passengers while providing ample space for luggage. This version is characterized by square—instead of round—windows, and there is no underslung gondola for the navigator, as on the military machine.

The agricultural version is the Mi-4S and the gondola is used in this model as a distributing point for chemicals.

The standard powerplant of the Mi-4 series is the ASH-82V developing 1,700 h.p. Provision is made for blind- and night-flying, and there is an anti-icing system, as on the smaller Mi types. The four-bladed main rotor has hydraulic servo control. A notable feature of the metal fuselage, especially from the military aspect, is the clamshell doors at the rear.

● Rotor diam., 68ft 11in; gross weight, 15,873 lb; disposable load, 2,645-3,527 lb; max. speed, 116 m.p.h.; ceiling, 19,750ft.

Mi-6 A photograph herewith shows this—the world's largest helicopter—flying in its latest form, i.e., with wings. A sectioned drawing showing freight stowage, engine installation, etc., appeared in *Flight* of January 9 this year. The engines are said to be "special free turbines designed by Solovyev." The five-blade rotor measures over 100ft in diameter and the disposable load is given as 12 metric tons. Possible loads are 80 fully armed soldiers or a maximum of 120 passengers.

This great helicopter has established a number of world records. On April 16 an aircraft of this type lifted 5 metric tons of cargo to a height of about 17,300ft. A load of 10 metric tons was raised to about 15,180ft.

Right, Mi-1

Possible pressure-jet helicopter In an interview Kamov has stressed the importance of the pressure-jet helicopter, which may mean that his team will be producing a machine of this class.

Yakovlev

Yak-24 Helicopters of this type are now flying with a redesigned tail, differing from that already familiar in having end-plate fins. The type is powered with two 1,700 h.p. ASH-82V fourteen-cylinder radial engines driving rotors similar to those of the Mi-4. The "box-car" fuselage is of steel tube construction, the centre portion being fabric-covered and the extremities having metal panelling. Combined with the rear section of the fuselage

Above, Mi-4. Lower right, Yak-24

Helicopters of the World . . .

is a loading ramp for wheel or track vehicles and heavy military equipment. The cabin measures some 33ft in length and will accommodate two lorries or jeeps, a twin 14.5 mm anti-aircraft gun with its crew, or as many as 40 troops with their service equipment.

● Rotor diam., over 56ft; gross weight, over 35,000 lb; cruising speed, 110 m.p.h.; range, up to 500 miles.

SPAIN

Aerotecnica S.A.

Velazquez 38, Madrid.

AC-12 A small batch of these two-seat utility helicopters has been made for the Spanish government by A.I.S.A. to designs produced by Jean Cantinieau, a Frenchman who joined Aerotecnica some years ago. Points of particular interest are the high concentration of mass achieved by mounting the Lycoming O-320 168 h.p. engine above the cabin, close to the rotor head. Two fans draw cooling air down through oil coolers past the two pairs of cylinders. The rotor head-controls are of ingenious layout and provide balanced, light forces without any form of power assistance. The blades are made up of a machined metal nose section with sheet-metal trailing edges and ribs filled with Klegecell foamed-resin compound. The whole is covered with resin-impregnated glass-fibre and is exceptionally strong. In one instance the rotor blades struck the ground during a test flight and did not disintegrate, only shedding some of the covering and filling. Weights at the blade-tips give the rotor very high inertia.

Skid landing gear is fitted and can support two stretchers outside the cabin. Main airframe structure is of stressed skin.

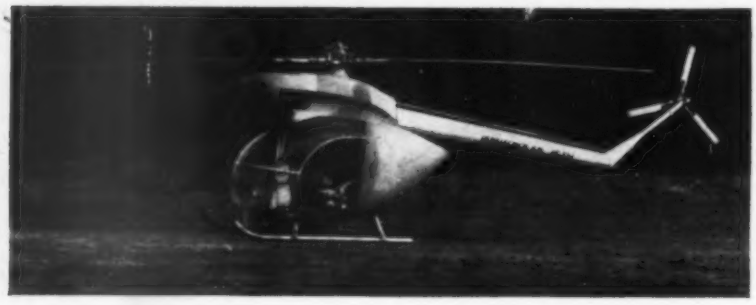
● Rotor diam., 27ft 10in; length, 22ft 8in; empty weight, 1,280 lb; gross weight, 1,800 lb; max. speed, 87 m.p.h.; cruising speed, 71 m.p.h.; hovering ceiling in ground effect, 7,870ft; range, 214 miles.

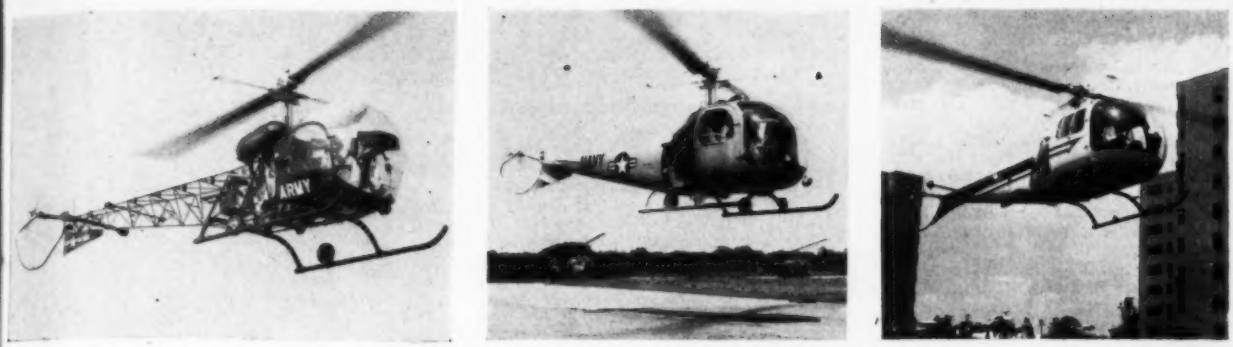
AC-14 Developed from the three-seat, turbine-powered AC-13, the AC-14 is powered by a Turboméca Artouste 2 giving

400 h.p., and carries five people or equivalent load. The engine is mounted, like that of the AC-12, above the cabin and the high-inertia rotor runs at constant speed. Construction of the four main-rotor blades is similar to that used in the AC-12, but the complication and relative unreliability of a tail rotor has, according to the designer, been avoided by using the residual thrust of the engine for anti-torque power. This air is led to the tail and vented into a bifurcated nozzle. The end of the tail-pipe can be swivelled from the rudder pedals to alter the proportion of air deflected in each direction and achieve directional control. At the same time the rudder linkage moves twin fins, which assist in providing directional control after engine failure. In order to increase the cruising speed, the bifurcated nozzle can be opened to vent the engine air straight backwards and provide forward thrust. In this condition, the aerodynamic rudders alone ensure directional control. Main-rotor controls are similar to those of the AC-12, providing direct control of the rotor by the pilot, but with very low forces and no power boost. ENHASA, the Spanish nationalized propeller company, has undertaken construction of a batch of six AC-14s for the Spanish Government. It was reported some years ago that the AC-14 should cost the equivalent of about £14,200. No firm details have yet been released concerning the AC-21 which was to have been an 8/10 seater powered by two Artouste 3s.

● Rotor diam., 31ft 6in; length, 26ft 6in; empty weight, 1,378 lb; gross weight, 2,646 lb; max. speed, 118 m.p.h.; cruising speed, 103 m.p.h.; hovering ceiling in ground effect, 16,075ft; range, 280 miles.

Above, Aerotecnica AC-14 (without engine cowling). Below, Aerotecnica AC-12





Three variants of the ever-popular Bell 47 range. L. to r. 47G-2 Trooper (alias H-13H); 47K (HTL-7) instrument trainer; and 47J Ranger

Helicopters of the World . . .

U.S.A.

Bell Helicopter Corporation

Fort Worth 1, Texas.

HU-1A Iroquois Known by the company designation Model 204, the Iroquois or HU-1A (U.S. Army designation) is a utility helicopter built round the Lycoming T53 free-turbine engine. Large-scale production is under way and during recent months helicopters of this type have been accumulating ten to thirteen hours' flying daily in an accelerated test programme. All components have been designed for a minimum of a thousand hours of operation between overhauls, and the aircraft is claimed to be capable of flying the equivalent of more than 110,000 miles between major inspections. A low silhouette places the cabin floor at knee height, permitting ease of loading of cargo or passengers. Wide sliding doors give quick access to the passenger/cargo area and separate doors open to the crew positions.

The following times are given for component replacement: engine, complete, 20 min; transmission, 40 min; main rotor and hub, 20 min; tail rotor hub and blade, 30 min; tail rotor gearbox, each, 20 min; landing gear, skid type, 30 min; oil cooler, 30 min; generator, main, 10 min; battery, 5 min.

A built-in sling-hook is provided for external freight carriage, release being controlled by the pilot; and provision is made for equipping the helicopter with more than 2,000 lb of armament, including rockets and machine guns. These can be controlled remotely by the pilot, or manned by gunners. The rockets are carried to a framework attached to the undercarriage structure and free-mounted guns can be installed in the large side windows. The cabin is quickly convertible for ambulance work and can carry four litter patients together with a medical attendant. Normal seating is for 6/8.

● Rotor diam., 44ft; fuselage length, 39ft 7in; gross weight, 5,800 lb approx.; hovering ceiling out of ground effect, up to 23,000ft; cruising speed, up to 125 m.p.h.; climb, up to 3,000ft/min at 10,000ft; range with ferry tanks, up to 540 miles.

47G-2 Trooper The commercial name Trooper has recently been conferred upon the G-2 model of the Bell 47; the type is otherwise known by the U.S.A.F. designation H-13H Sioux. Standard fittings include: Lycoming 260 h.p. engine de-rated to 200 h.p. for extra life and with spare power available for hot weather and high-altitude operation; hydraulically boosted controls; skid-type undercarriage with wide tread and with cross tubes permitting quick attachment of cargo carrier or stretcher. Optional are dual controls; external cargo bins of 400 lb capacity; rotor brake; flotation gear; night flying equipment; external stretchers; and a muff-type heater-defroster. The Trooper carries up to three people with baggage.

● Main rotor diam., 35ft 1in; overall length, 41ft 5in; gross weight, up to 2,450 lb; vertical take-off ceiling, up to 16,250ft; service ceiling, up to 17,500ft; cruising speed, up to 93 m.p.h.; cruising range, up to 3.6 hr.

47J Ranger The Ranger is a refined version of the basic Model 47 helicopter, carrying a pilot and three passengers. It can be supplied with standard or de-luxe passenger interiors; the standard finish has removable soundproofing material in wash-

An uncommonly fine study of a Bell HU-1 Iroquois carrying a 2,600 lb jeep at a speed of 60 kt

Helicopters of the World . . .

able plastic for the coverings and removable seat cushions. The bubble canopy is tinted to lessen eye fatigue. The custom interior is designed by Horton and Horton, and optional equipment includes night flying equipment; choice of popular V.H.F. radios; stretcher kit allowing two patients to ride inside the cabin; an internal electric hoist which permits the pilot to direct the lift of a 400 lb load into the cabin without the need of extra crew; rotor brake; heater-defroster; and flotation gear. As in the Trooper, the engine is a 260 h.p. Lycoming derated to 240 h.p.

● Rotor diam., 37ft 2in; overall length, 43ft 4in; gross weight, up to 2,850 lb; vertical take-off ceiling, up to 13,700ft; service ceiling, up to 19,700ft; cruising speed, up to 105 m.p.h.; cruising range (with optional 48-gal tanks), up to 3.4 hr.

47K This is the Bell designation of the HTL-7 instrument trainer which, as the picture (p. 689) shows, resembles the 47J.

XV-3 The XV-3 is an experimental convertiplane powered with a Pratt and Whitney R-985 engine of 450 h.p. It is included here because it takes off vertically in the manner of a helicopter by virtue of its large diameter rotor/propellers. The twin three-bladed rotors are mounted near the tips of the relatively small wing, with the axes of the rotor masts vertical for "helicopter" operation. After a certain speed is reached the masts are tilted forwards through about 90 deg, so that the rotors are then acting as propellers. During conversion (which requires between 10 and 15 seconds) the lift load is transferred to the wing, and after conversion a transmission gear-change, similar to a car overdrive, is used to reduce rotor speed and thereby to attain improved high-speed performance.

A Bell announcement last December read:—

"Aviation history was made at Fort Worth on December 18 when the XV-3 convertiplane achieved 100 per cent in-flight conversion of its tilting rotors. Bell test pilot Bill Quinlan described the conversion manœuvre as 'smooth and comfortable.' The full conversion was the world's first by a tilting-rotor, fixed-wing aircraft. . . . This attainment by the aircraft occurred at a 4,000ft altitude and 115 kt airspeed. . . . Maximum airplane speed of the XV-3 is estimated to be 150 kt. . . . Bell convertiplane engineers said future, larger versions would have more than double this speed capability. . . . Bell said flight testing of the convertiplane would be continued to determine stability, control and performance characteristics of the craft in airplane flight."

● Rotor diam., 25ft; length, 30ft; empty weight, 3,490 lb; gross weight, 4,700 lb.

Bensen Aircraft Corporation

Raleigh-Durham Airport, Raleigh, North Carolina.

B-7M Gyro-Copter This tiny autogyro has a Nelson H-59A (four-cylinder, horizontally opposed two-stroke) engine of 42 h.p., driving a wooden propeller (the rotor being unpowered). A hanging-stick control lever operates in conjunction with the rudder pedals and a twist-grip throttle. The main structure is of aluminium tubing and the undercarriage is of nosewheel type. The makers list standard equipment as airspeed indicator, 1,000 lb safety belt, steel cable pull starter, six-volt battery, wheel-type landing gear and tow hitch; and optional equipment as altimeter, compass, shoulder harness, auxiliary fuel tank and float type landing gear.

● Rotor diam., 20ft; length (less rotor), 8ft 7in; empty weight, 180 lb; gross weight, 450 lb; max. speed, 75 m.p.h.; cruising speed, 60 m.p.h.; min. level speed, 15 m.p.h.; take-off speed, 20 m.p.h.; landing speed, 7 m.p.h.; range, 100 miles; service ceiling, 12,500ft; max. rate of climb, 950ft/min. (Figures are approximate.)

B-7W Hydro-Glider A towed rotor kite using components of the B-7M and having a float undercarriage.

B-8M Gyro-Copter This improved Gyro-Copter has a McCulloch engine. Aircraft of the type are now being assembled privately in this country and *Flight* of April 24 reported:—

"The most suitable engine available, and that recommended by Bensen, is the four-cylinder two-stroke McCulloch of 100 cu in capacity. The engine produces an output of about 75 b.h.p. for a weight of 75 lb. Over 32,000 of these engines have been made for target aircraft and are available on the American surplus market. They must, however, be modified if longevity is to be achieved. The power output is excessive for the basic single-seater Gyro-Copter, but it allows great scope for development as well as providing a rate of climb approaching 2,000ft/min. Fitted with power transmission to the rotor, for starting, the machine should take-off in the length of a tennis court at an airspeed of about 20 m.p.h. It will descend into a smaller area at an airspeed of 7 m.p.h., and in common with most autogyros it can descend vertically with some loss of control."

B-8W Hydro-Glider This towed rotor kite has a twin-float undercarriage.

Bensen B-8M

Brantly Helicopter Corporation

24 Maplewood Avenue, Philadelphia 44.

B-2 The B-2 is a side-by-side two-seater powered with a Lycoming VO-360 A1A rated at 180 h.p. on 91-octane fuel. The engine is mounted with the crankshaft vertical and has exhaust-induced cooling. A novel design of three-blade rotor has been evolved, with a diameter of only 23ft 8.9in. The blades are of all-metal construction, with a solid extruded aluminium-alloy leading edge and combined flapping and drag hinges near mid-span. Empty weight with radio is only 980 lb and the structural gross weight is 1,600. With over three hours' supply of fuel, cruising at 100 m.p.h., the residual payload is 460 lb so that, even with two adults and 50 lb of baggage, lifting power remains for external loads or special gear. An overload of an additional 200 lb can be handled under emergency conditions.

The Brantly Corporation reports that distributors have been established throughout the United States, in South America and "in the European area." (In *Flight* of January 30 last the following announcement appeared: "Brantly Helicopters Ltd. (managing director R. F. Daniel) was formed last autumn, with a registered office at 131 Ystrad Road, Fforestfach, Swansea, Glam.")

● Rotor diam., 23ft 9in; fuselage length, 21ft 9in; hovering ceiling at gross weight in ground effect (4ft above surface), 4,700ft; service ceiling, 9,700ft.

The Bell company's caption to this picture reads: "Bell Helicopter Corporation's XV-3 convertiplane shown in world's first 100 per cent conversion of a fixed-wing, tilting rotor aircraft. This photo made December 18, 1958, at 4,000ft near Fort Worth, Tex. Speed was 115 kt"

Helicopters of the World . . .

Cessna Aircraft Corporation

Wichita, Kansas.

CH-1C This clean-lined helicopter is an improved version of the YH-41, as supplied to the U.S. Army. A specialized version, adapted specifically as an instrument trainer, is now being demonstrated to the U.S. Armed Forces. The makers feel that the -1C represents a real technical advance, by virtue of its inherent stability. They report:—

"In the light helicopter field the stability of the CH-1C is unsurpassed. It is completely stable in roll, pitch, and yaw allowing indefinite hands-off flight . . . The pilot is not aware of the control inputs from the gyro stabilizing mechanism due to the fact that a mixing linkage is used which prevents feed back from the system to the cyclic stick. No aerodynamics penalty is paid for stabilization because it is completely enclosed within the airframe . . . Control response has not been sacrificed. Doubly effective in cross-wind hovering and manoeuvring is the large tail rotor which provides powerful directional control."

The following claims are also advanced:

"The versatile functional design of the CH-1C lends itself to a degree of operational efficiency heretofore unattainable in any single helicopter. The forward-mounted engine installation affords maximum accessibility and ease of maintenance. This configuration permits a direct drive from the engine to the simple, long-life transmission consisting of a rugged ring gear and pinion and a take-off gear to power the tail rotor. The transmission and engine location permit a cabin design with unlimited visibility in every direction . . ."

The engine is a Continental FSO-526A of 270 h.p. and the total cabin volume 201 cu ft.

● Rotor diam., 35ft; max. length, 42ft 6in; empty weight with standard equipment, 2,065 lb; gross weight, 3,100 lb; max. speed at s.l., 122 m.p.h.; cruising speed, 92-120 m.p.h.; hovering ceiling at gross weight at 95 deg F in ground effect, 6,500ft; normal range, 226 n.m.

Doak Aircraft Co. Inc.

22309 Western Avenue, Torrance, Calif.

Model 16 No great amount of information on this interesting VTOL aircraft has been released, but when the photograph on this page was issued last November it was stated:—

"Using the National Aeronautics and Space Administration's High Speed Flight Station at Edwards, the Doak 16 first will make transition flights. With ducted propellers on wing-tips aimed straight up, the novel aircraft first will rise vertically, then slowly rotate ducts forward in transition to horizontal flight, then rotate ducts back and land vertically. It is powered by an 825 h.p. Lycoming T53 shaft turbine engine. Once in air, Doak 16 will operate as conventional airplane with much higher speed and longer range than helicopters. Where airports are available it will also take off and land horizontally as conventional aircraft. This requires less power for take-off and therefore permits carrying extra fuel loads for even greater range. After transition flights the Doak 16 will move into normal airplane category, where higher speeds will be studied."

Length, 32ft; gross weight, 2,700 lb.

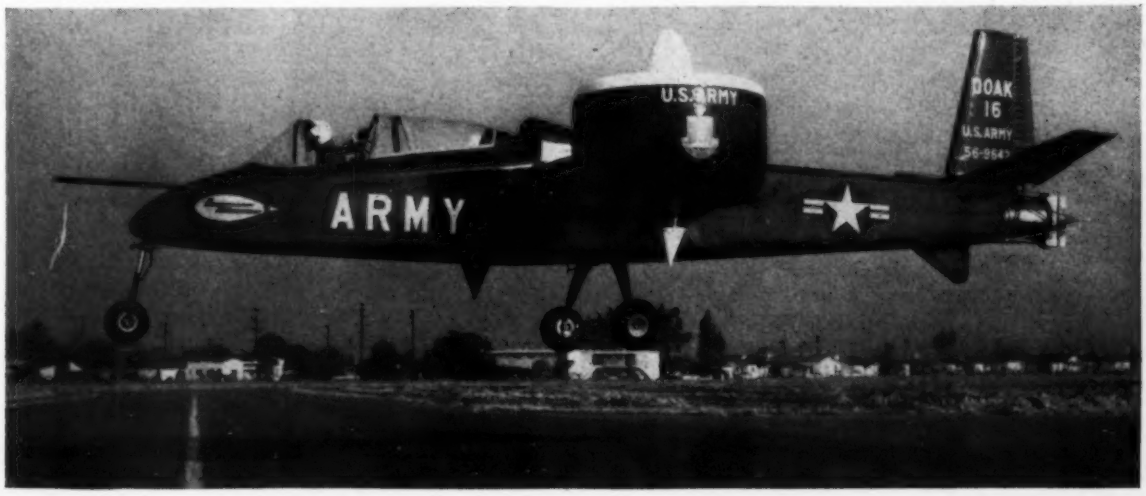
Above, Brantly B-2. Below, Cessna CH-1C

Doman Helicopters Inc.

Danbury, Conn.

LZ-5 This is an eight-seater helicopter with an unconventional rotor system, described in our former review (*Flight*, March 21, 1958). The welded steel tube fuselage is covered with magnesium alloy sheet, and the Lycoming SO-580-A1B engine is installed in the nose. Most of the skinning of the aircraft is non-structural and may be easily removed to convert to the stripped configuration for greater payload, repair or refinishing. The ability to utilize the stripped configuration is valuable for cargo operation since it increases the payload by approximately

Shown below in hovering flight is the Doak Model 16



Doman LZ-5

Helicopters of the World . . .

20 per cent. For shipping or crating, the fuselage may be readily disassembled into smaller components. The cabin is easily converted from cargo to passenger use in a matter of minutes, and there is a very large window by each seat.

● Rotor diam., 48ft; fuselage length, 38ft; empty weight, 3,250 lb; gross weight, 5,200 lb; max. continuous speed, 100 m.p.h.; speed for best range, 81 m.p.h.; range (standard tanks), 486 miles.

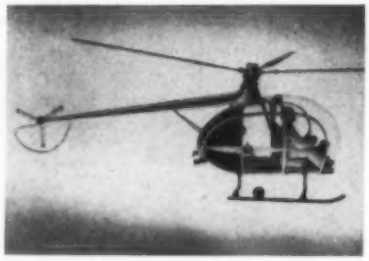
Whippet Depicted on this page is a model of this forthcoming four-seater which Doman hope to market for $18,500. A cost per seat mile of 6.5 cents is forecast, and this is said to be a quarter that of current small helicopters. Delivery within two years is quoted. The engine is a Lycoming VO-360 of 180 h.p., driving a three-blade main rotor.

● Gross weight, 1,940 lb; max. speed, 132 m.p.h.; speed for best range, 103 m.p.h.; rate of climb, 1,500ft/min; service ceiling, 15,000ft; range (with 15 min reserve), 206 miles.

Gyrodyne Co. of America Inc.

St. James, Long Island, N.Y.

XRON-1 Rotorcycle The makers communicate the following note on this little helicopter: "The XRON-1 Rotorcycle is a small one-man coaxial helicopter which has been developed under U.S. Navy con-



Doman Whippet

tract for use by the Marine Corps in missions involving observation, liaison, and small unit tactical maneuvers. This helicopter has successfully completed a Flight Demonstration Program for the U.S. Navy, and has also been test flown by a number of military pilots. The company is currently engaged in producing a limited quantity of the Rotorcycles for evaluation by the Marine Corps.

"The Rotorcycle incorporates two two-bladed coaxial rotors of the semi-rigid (see-saw) type. The blades are of wooden construction. The powerplant is the Porsche Model GP-702/1 production-type 1,600cc helicopter engine developed by the Porsche Company specifically for the XRON-1. Although the project is strictly military to date, the Company intends eventually to certificate the machine with a view to marketing the civilian version.

"During the past year Gyrodyne has developed an automatic stabilization and remote control system for the Rotorcycle. Many successful test flights have been made with the Rotorcycle in this configuration."

● Rotor diam., 17ft; fuselage length, 11ft; empty weight, 425 lb; gross weight, 690 lb; max. speed at s.l., 69 m.p.h.; cruising speed at s.l., 51 m.p.h.; max. rate of climb, 600ft/min; service ceiling, 6,500ft; normal range, 51 n.m.

Hiller Aircraft Corporation

Palo Alto, California.

12E In Hiller's 1958 annual report it was remarked: "With the 1958 launching of the 12E three-place utility helicopter into the civilian market, a new phase in Hiller aircraft production was begun. The 12E signalled the initial step in a long-range programme to increase the ratio of commercial to military business." It was further stated: "Power is the answer to the 12E's exceptional ability. In addition to its Lycoming 305 h.p. engine, the 12E possesses a rugged H-23D Army-tested airframe which provides the high dependability factor essential to safe, profitable operations. The 12E evolved from the H-23D without major redesign cost, since its military counterpart's components were originally engineered to accept more than the 250 h.p. installed. Consequently, as soon as the new Lycoming 305 h.p. engine was available, it was incorporated with only minor accessory changes."

● Rotor diam., 35ft 6in; fuselage length, 27ft; empty weight, 1,700 lb; gross weight, 2,700 lb; max. speed at s.l., 95 m.p.h.; cruising speed for max. range, 82 m.p.h.; max. rate of climb, 1,520ft/min; hovering ceiling in ground effect, 10,100ft; range, 185 miles.

H-23D Raven This is the current military Hiller and has a three-seat dual-control cockpit. The engine is a 250 h.p. Lycoming VO-435, and in comparison with earlier military types the transmission and drive system have been redesigned. The transmission, it is claimed, has virtually infinite life and is good for over a thousand hours' operation between overhauls.

● Rotor diam., 35ft 4in; fuselage length, 27ft 8in; weight empty, 1,773 lb; gross weight, 2,700 lb; max. speed at s.l., 95 m.p.h.; cruising

Hiller 12E

speed at s.l., 82 m.p.h.; service ceiling with normal load, 13,200ft; max. rate of climb at s.l., 1,050ft/min; hovering ceiling in ground effect, 5,200ft; range at s.l., 197 miles.

H-23D-1 This is the military counterpart of the 12E, fitted with a Lycoming VO-540 engine of 305 h.p. Indicative of its lifting capacity was a test flight made with a 900 lb Army "mechanical mule" suspended from strongpoints.

XROE-1 Rotorcycle Of this small helicopter the makers report:—

"In 1954 Hiller Helicopters was selected by the U.S. Navy Bureau of Aeronautics to build the company's proposed design of a one-man helicopter for the Marines. The Rotocycle completed its flight testing in July 1957. During the course of this most successful programme the full potential of the tiny helicopter as a high production aircraft became increasingly evident. . . . The XROE-1 Rotorcycle represents the minimum practical size in helicopters. Weighing but 300 lb, it achieves a gross-to-empty weight ratio of approximately 2, a value unprecedented in mechanically driven helicopters. This low weight is particularly significant in that (1) small size has always compounded the weight problem, and (2) unusual design problems had to be overcome to obtain the Rotorcycle's unique feature of complete foldability. In answer to a U.S. Navy requirement that the XROE-1 be easy to fly, the Hiller Rotormatic Control System was incorporated. This control rotor system increases inherent stability, and its servo action results in almost complete elimination of cyclic control forces. The control 'paddles' may be easily adjusted by the user to vary control rotor response. Thus, the same helicopter can be made sensitive or sluggish depending upon operational needs or pilot experience."

Hiller XROE-1 Rotorcycle

The engine is a Nelson Model H-63 two-stroke, four-cylinder, horizontally opposed, air-cooled unit, rated at 45 h.p.

Of the Rotorcycle's military applications the makers remark: "Immediate intelligence and communications control can be initiated in the fluid combat situation and with minimum logistic effort by employing Rotorcycles for airborne surveillance and inspection, light wire laying, courier work, and as an airborne communications station. Rotorcycles may also be used to transport small but critical re-supply items and equipment; folded within a streamlined pod, it may be air dropped from the lightest of military aircraft as a rescue or evacuation vehicle; used in force, assault troops and patrols can move unannounced into strategic enemy areas."

A licence for construction of the Rotorcycle is held by Saunders-Roe Ltd.

● Rotor diam., 18ft 6in; empty weight, 300 lb; gross weight, 496 lb; max. speed at s.l., 70 m.p.h.; cruising speed, 52 m.p.h.; max. rate of climb at s.l., 1,160ft/min; hovering ceiling in ground effect, 9,200ft; range at s.l. with 170 lb pilot, 166 miles.

X-18 This aircraft is not a helicopter in the generally accepted term, but is lifted into the air, in the manner of a helicopter, by its coaxial propellers. Essentially it is a Chase C-122 with a new, tilting, wing and two Allison YT40 turboprops. In a lecture the X-18 project engineer has described the tilt-wing system in these terms: "A lever is incorporated on the pilots' control pedestal to actuate the wing tilt hydraulic system. A duplicate cable system runs from the control pedestal aft to a pair of hydraulic valves placed close to the wing tilt cylinders. Each valve actuates a wing tilt actuator—one at each side of the fuselage. Either actuator is capable of tilting the wing in the event of failure of the opposite hydraulic system."

● Span, 48ft; length, 63ft; design gross weight, 33,000 lb.

Hughes Tool Company, Aircraft Division

Culver City, Cal.

Model 269A Known to the U.S. Army as the YHO-2HU, this little helicopter also has civil applications, and a civil model has already been flown. The makers describe the machine in these terms:—

"The YHO-2HU is a fully reliable, easily maintainable, high performing, low cost two-place helicopter for observation, liaison and training. With its hedgehopping abilities and extremely small silhouette, the YHO-2HU will reduce the hazards of enemy fire. It is easy to land, park and conceal. Pilots have said that this helicopter gives an exceptionally smooth vibration-free ride. It is rugged in construction and simple in design to give a high degree of operational availability without being laid up for repairs or time-consuming maintenance. The all-metal main rotor blade of bonded wrap around skin construction is factory-balanced, completely interchangeable, and does not require retracking in service. The rugged gearboxes utilize a simple automotive type ring gear and pinion for both the main and tail rotors, with consequent dependability. The completely trouble-free multiple belt drive-clutch provides efficient power coupling and isolates engine vibration from the rotor system, controls and cockpit. The engine, multiple belt drive-clutch, main gearbox and rotor system are all independently installed. All assemblies are designed to make incorrect assembly impossible. The easily accessible Lycoming O-360 engine is used in the same horizontal position and at the same engine speeds that have proven so successful in light planes. Access to all components is unhampered by structures or closures and the various parts are easily inspected visually."

● Rotor diam., 25ft; length, 28ft; empty weight, 915 lb; design gross weight, 1,550 lb; max. cruising speed at s.l., 85 m.p.h.; service ceiling, 11,000ft; hovering ceiling in ground effect, 5,000ft; normal range, 150 miles.

Gyrodyne XRON Rotorcycle

Hughes Model 269A

Kaman Aircraft Corporation

Bloomfield, Conn.

HU2K-1 Built for the U.S. Navy, this machine is described as a high-speed, all-weather, utility helicopter powered by a General Electric T58 gas turbine and equipped with automatic stabilization equipment and the latest in electronic flight and navigation aids. It has a retractable undercarriage and a four-blade main rotor using the proven Kaman servo-flap control system.

Announcing a follow-on order for helicopters of this type in March last year the makers stated: "The basic helicopter is designed so that it is able to accomplish a wide variety of missions such as rescue, carrier plane guard, litter evacuation, transport of externally slung cargo, per-

Hiller X-18

Helicopters of the World . . .

sonnel transport and observation-reconnaissance missions. A special feature of the HU2K-1 will be its self-contained flotation equipment capable of filling emergency flotation bags with gas at 20 deg C within two seconds. Operational data, concerning speed, range, payload capacity and other details of the performance of the aircraft, are classified.

As seen below, external fuel tanks are a feature. It is unofficially stated that up to 14 seats can be fitted.

● Rotor diam., 44ft; max. length, 52ft 2in; empty weight, 5,050 lb; gross weight, 9,150 lb.

Left, Kaman H-43B Huskie. Right, Kaman K-17

Kaman HU2K-1

H-43B Huskie This interesting helicopter has been developed specifically for crash rescue missions. The makers communicate the following information:—

"The Kaman Huskie, the H-43B, is the latest helicopter to go into service with the United States Air Force and the only one they are currently ordering for their own use. The H-43B, which is a development of the service-proved HOKs, HUKs and H-43As, is powered by a Lycoming T-53 gas turbine engine.

"The Huskie will fill the local base crash-rescue mission at air bases in this country and overseas. It comes equipped with hoist, litter racks and a specially designed fire-rescue kit, including 82 gallons of foam extinguishing chemical, hose, crowbars, axes, etc. Because it can search and rescue so effectively, unhampered by lack of roads, rough terrain and other hazards to ground travel, the H-43B is uniquely adapted to this job.

"Effective short-range rescue is measured in the minutes and seconds it takes to get to the scene where help is needed and take immediate action. As it has no tail rotor, the Huskie can land safely in thick brush and confined places, and its bear-paw landing gear makes it possible to set down in swamps, mud, ice and sand. Its turbine engine needs no warm-up, and even in arctic weather, it can be airborne within seconds.

"This new Air Force helicopter features several well known Kaman developments, including servo-flaps, intermeshing rotors, and in-flight tracking. Servo-flaps are small aileron-like controls mounted behind the rotary wings. They make possible lighter, more sensitive control as well as greater stability. The intermeshing rotors permit a symmetrical design in which torque is inherently equalized and balanced. All of the power of the engine can be translated into lift. In-flight tracking is a Kaman-developed system that enables the pilot to track either rotor by a simple switch right in the cockpit."

● Rotor diam., 47ft; length, 47ft; empty weight, 5,900 lb; gross weight, 7,100 lb; max. speed, 107 m.p.h.; hovering ceiling in ground effect, 20,000ft; normal range, 250 miles.

K-17 This experimental aircraft is a gas-turbine-powered, cold-cycle, tip-jet helicopter. The turbine runs a compressor, and compressed air is passed through the rotor tips. The system is thought to hold promise of "an answer to the need for simplicity." The company plans to use the helicopter as a testbed in conjunction with the evolution and development of jet rotor propulsion. The engine is a Turbomeca Turmo of 400 e.s.h.p.

● Rotor diam., 37ft; empty weight, 950 lb; gross weight, 2,000 lb; max. speed, 80 m.p.h.

K-16B A forthcoming VTOL/STOL research aircraft using a Grumman Goose amphibian hull which is being fitted with a new wing and powerplant. Essential characteristics are seen in the artist's impression on this page. The engines are General Electric T58 turboprops.

Remotely-controlled Helicopter The makers report that the development of their remotely-controlled helicopter continued throughout 1958. They add: "Navy evaluations completely proved the feasibility of the remotely controlled helicopter as a destroyer-based, anti-submarine weapon. The remote control system has been developed to the point where non-pilots regularly operate the Kaman HTK-1 radio-controlled helicopter. In tests aboard destroyers of the Atlantic Fleet it has been demonstrated through the use of a radar screen that it was possible to fly the remotely-controlled helicopter at ranges of more than ten miles."

Fairey Rotodyne Licence Kaman is licensed to build and sell the Rotodyne in the United States and possessions. The company remark:—

"While New York Airways placed their initial order directly with Fairey, in order to take advantage of the earliest possible delivery date, the announcement calls further attention to the tremendous potential of the Rotodyne's unique ability."

McDonnell Aircraft Corporation

St. Louis 3, Mo.

XV-1 This convertiplane is an experimental aircraft designed to study the principle of the unloaded rotor for possible use in larger aircraft of similar design. A speed of more than 200 m.p.h. was claimed to have been achieved many months ago.

The rotor is driven by McDonnell-developed pressure-jets at the tip of each of the three blades. The pusher propeller is powered by a Continental R-975-19 piston engine, which also drives compressors for the supply of air to the pressure jets during "helicopter" flight. The machine carries three passengers or two stretcher patients and a medical attendant in addition to the pilot. The pilot and co-pilot/observer sit in tandem and dual controls can be fitted. The exit doors are jettisonable. A tailplane carrying tabs is mounted between the two tail booms. The non-retracting skids comprise the landing-gear, and the installation is unusual in that energy is absorbed during a hard landing by yielding, replaceable, stainless-steel straps.

Two XV-1s have been flown (see picture on next page).

● Rotor diam., 31ft; overall length, 31ft; empty weight, 4,277 lb; gross weight, 5,505 lb; hovering ceiling in ground effect, 7,500ft; normal range, 300 miles.

Model 120 This is a new cargo helicopter which is thought by its makers to be capable of lifting more weight for its size than any other similar craft. It is a private venture and is described by McDonnell as follows:—

"A revolutionary rotor and drive system, combined with a utility type airframe of un-

Kaman K-16B

Helicopters of the World . . .

precedented simplicity and versatility, make the new helicopter unique in several respects. McDonnell design engineers have incorporated proven departures from most features of conventional helicopters that have caused maintenance difficulties, operational problems and low availability. The new craft has an empty weight of only 2,400 lb and a maximum take-off gross weight of 6,300 lb. The useful load is 62 per cent of gross weight, unusually high for a helicopter. This high useful load is achieved by using a McDonnell-developed pressure jet-powered rotor. The pressure jet burners are mounted on each of the three rotor blade tips. Compressed air is ducted through the rotor hub and rotor blades to the pressure jets where fuel is injected and burning occurs.

"The compressed air for the pressure jets is supplied by three AiResearch GTC-85-35 gas turbine compressors. . . . The three compressors afford true multi-engine reliability since level flight can be maintained at maximum gross weight with one engine inoperative. The engines are mounted at shoulder height and can be changed in five minutes without the use of any tools.

"The fuselage is extremely simple in design in order to minimize maintenance and to facilitate cargo loading. Cargo is carried suspended from a pilot-controlled cargo hook located immediately below the rotor. Twelve people can be accommodated on 'toboggan seats' which attach to the cross member supporting the cockpit and a similar aft member which is a part of a 'personnel kit.' The kit will contain an enclosure to protect the occupants from wind and downwash. . . ."

● Rotor diam., 31ft; empty weight, 2,450 lb; gross weight, 6,300 lb; max. speed, 138 m.p.h.; hovering ceiling in ground effect, 12,000ft; normal range, 98 miles.

Above, McDonnell XV-1s. Right, McDonnell Model 120

Omega Aircraft Corporation

Municipal Airport, New Bedford, Mass.

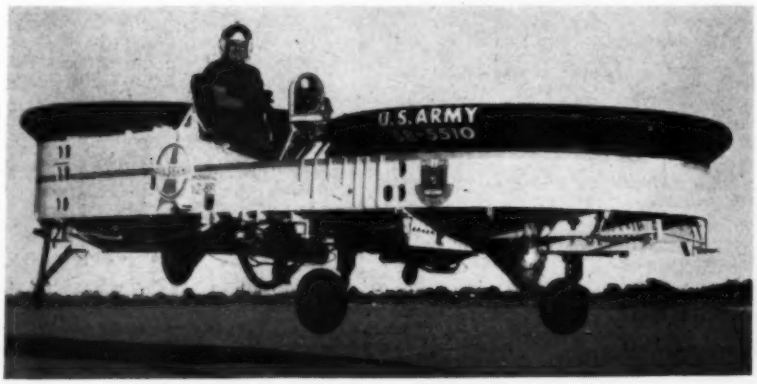
BS-12 This is a strong, utility helicopter designed for a wide variety of commercial applications. It embodies a five-seat cabin forward and a large cargo area directly beneath the rotor centre-line. Cargo can be carried in this area in a detachable pod, in a net sling, or suspended from the surrounding fuslage structure as a separate unit.

The fuselage is a welded tubular steel frame with the aft portion uncovered for ease of inspection and repair and for better stability and vibration characteristics. Two Lycoming O-540-F1B5 engines are mounted externally. The four-blade main rotor system consists of two identical two-bladed fully articulated rotors. The blades are of laminated birch and spruce, covered with fibreglass, and with a stainless-steel abrasion cover on the leading edge.

The BS-12 is being offered in "Intercity" (executive) and "Cargo" versions. Installation of Allison T63 turboshaft engines is being studied.

● Rotor diam., 39ft; overall length, 48ft; weight empty, 3,300 lb; gross weight, 4,750 lb; max. speed at s.l., 95 m.p.h.; economical cruising speed, 75 m.p.h.; best rate of climb (continuous power), 1,200ft/min; hovering ceiling in ground effect, 6,200ft.

Above, Omega BS-12. Below, Piasecki VZ-8P "Aerial Jeep"



Piasecki Aircraft Corporation

International Airport, Philadelphia 42, Penn.

VZ-8P "Aerial Jeep" This vehicle has been built to combine the advantages of the land-borne jeep and the small helicopter. The makers say "It can travel along the highway, hop bombed-out bridges, skip over unimproved terrain and maintain a constant hug-the-ground altitude en route." They add: "The two shrouded 'rotor-propellers' are arranged in tandem. The engines are located on either side, between the rotors, driving inward to a central gearbox which distributes the power forward and aft to each rotor. The pilot sits on the right side, above one of the engines. The two engines are displaced to the left in order to balance the pilot's weight. Space is provided at the centre of the machine, to the left of the pilot, for additional passengers or cargo. The landing-gear consists of two main wheels forward of the centre of gravity, and a swivelling tailwheel."

In March it was reported that the aircraft had been making on-the-spot turns in winds up to 20 m.p.h., and stopping quickly in mid-air. At that time 34 hr of test flying had been logged.

The engines are two Lycoming O-360s.

Sky-Car The proposed civil development of the VZ-8P is shown in the artist's impression below.

Artist's impression of Piasecki Sky-Car

Sikorsky S-60. This "crane" helicopter is seen lifting a weighted dummy of the Honest John missile

Helicopters of the World . . .

Sikorsky Aircraft Division of United Aircraft Corporation

Stratford, Conn.

S-64 This designation is reported for a projected amphibious transport development of the S-56/S-60 type helicopter.

S-63 Our contemporary *Aviation Week* alludes to this projected helicopter as having the same rotor as the S-62 and as being powered with a General Electric T58-8 of 1,250 s.h.p. Maximum speed is quoted as 155 m.p.h., hovering ceiling in ground effect as 6,500ft, and normal still-air range as 225 miles.

S-62 This notable aircraft is the first amphibious helicopter to be built with a flying-boat hull. This feature permits landings on, and take-offs from, land, water, ice, snow, swamp or tundra. The S-62 represents the successful blending of a new airframe and a modern gas turbine powerplant with the mechanical components of the long-established S-55 type. S-55 components include all main and tail rotor heads and blades; main, intermediate and tail gearboxes; shafting; tail rotor pylons; and major portions of the flight control and hydraulic systems.

The V bottom of the hull, designed to cushion impacts when alighting on water and to throw spray outwards and downwards, is entirely watertight. For land operation wheels are mounted under two floats. Located forward and well away from the fuselage these floats resist pitching and rolling during landings or while the helicopter is at rest on the water. Another advantage of the flying-boat hull, the makers claim, is that it weighs much less than a land-type hull equipped with inflated pontoons for water alightings. They add:—

"The S-62 hull also eliminates much of the drag associated with pontoon-type flotation—both in flight and in the water. This is particularly important in auto-rotative, or power-off, landings where the helicopter enters the water with forward speed. Conventional cylindrical floats tend to nose the aircraft over when striking the water, while the S-62's boat hull provides water landing and handling qualities hitherto unknown to helicopters. . . . Equipment includes a 600 lb-capacity rescue hoist, an external cargo sling capable of carrying 3,000 lb, internal ferry tanks, an adaptation of the S-55 winterization kit tested at minus 65 deg, pilot and co-pilot oxygen provisions, and a towing attachment to provide 4,000 lb of pull for such work as removing damaged aircraft from runways or assisting ground equipment which may have become mired or disabled."

Typical accommodation is for 10-12 passengers and a land version—rather faster and carrying 300 lb more payload—will be available. Alternative powerplants are the General Electric T58-GE-6 and Lycoming T53-L-1. Data relate to the former installation.

● Rotor diam., 53ft; overall length, 62ft 3in; basic weight, 4,550 lb; gross weight, 7,500 lb; max. speed, 117 m.p.h.; cruising speed, 98 m.p.h.; hovering ceiling out of ground effect, 8,000ft; service ceiling 15,700ft; range, 230 miles.

S-61 The foregoing is the Sikorsky designation of a new class of helicopter at present represented by the HSS-2, subsequently described. The designation will be used for a forthcoming civil helicopter generally resembling the HSS-2 but equipped to carry 25 passengers. Los Angeles Airways, who have already bought S-62s, say of the S-61, for which negotiations are in hand, "We feel it will fulfil our requirements for a multi-engined all-weather helicopter capable of handling high-volume business over longer distances." The civil machine, powered with General Electric T58s, should be available early in 1961.

HSS-2 The HSS-2 is the world's largest amphibian helicopter and is the first all-weather helicopter to be supplied in quantity to the U.S. Navy. The boat hull feature has been described in connection with the S-62. Two General Electric T58-6 gas turbines of about 1,050 s.h.p. are mounted side by side above the fuselage. Anti-icing equipment is provided for the rotor blades and advanced submarine detection gear and an improved navigation system, developed jointly by the U.S. Navy and Sikorsky, is installed. The HSS-2 is the first helicopter procured under the U.S. Navy's new weapon system concept, and in addition to designing and fabricating the airframe Sikorsky also had the responsibility of developing, procuring and testing all major installations such as sonar, electronic devices, navaids and support equipment. Other points of note are the 600 lb-capacity rescue hoist and the fully automatic blade-folding equipment for carrier stowage. A 6,000 lb-capacity automatic touchdown-release cargo sling can be installed to carry external loads. A Marine Corps version, to be known as the HR3S, will be used as a troop carrier.

S-60 This is a massive "crane" capable of transporting a six-ton cargo on external slings or hoists. The first model has Pratt and Whitney R-2800 piston engines; later aircraft will be powered by gas turbines. Discussing this aircraft Sikorsky's engineering manager has said:—

"The crane helicopter could be the key to creation of new enterprises. It could be used to carry prefabricated houses, sections of

Below, Sikorsky S-62. Lower right, Sikorsky S-61

Sikorsky HSS-2

Helicopters of the World . . .

bridges, and sections of power transmission towers. Many kinds of construction work, now handicapped by lack of roads and bridges, could be done easily by the flying crane. The crane helicopter might also prove useful in speeding delivery of goods between factories and such transportation centers as airports, piers, railroad yards and truck depots. It might carry detachable cargo pods. . . .

"An entirely new cockpit design will give the pilot a range of vision believed unprecedented in any other aircraft. A glass-enclosed cabin will provide unobstructed vision in any direction. The pilot's seat will swivel to the rear so that he may obtain a clear view of loading and unloading operations. In the rearward facing position, he will operate a separate set of controls and will look almost directly down the hoist to the cargo. . . .

"Main and tail rotor heads, blades, transmission parts and drive shafts of the S-56 are incorporated."

S-58 Well over a thousand of these aircraft have now been supplied to commercial operators, the U.S. Navy (HSS), Army (H-34), Marines and Coastguard (HUS). Seating capacity is for pilot and co-pilot and 12-18 passengers; or alternatively eight stretchers or a 4,000 lb load can be carried for 100 miles. Internal cargo capacity is 405 cu ft. A 5,000 lb-capacity automatic touchdown-release cargo sling can carry external loads and provision is made for a 600 lb-capacity hydraulically operated hoist. Military versions have automatic stabilization equipment. The rotor blades are of all-metal construction and the engine is a Wright Cyclone C989HE2 (1,525 h.p. for take-off).

● Rotor diam., 56ft; overall length, 65ft 10in; empty weight, 7,675 lb; gross weight, up to 13,600 lb; max. speed, 123 m.p.h.; cruising speed, 98 m.p.h.; rate of climb at s.l., 1,100ft/min; service ceiling, 10,500ft; hovering ceiling in ground effect, 4,900ft; range, 260 miles.

S-56 This very large helicopter is used by the U.S. Army (H-37) and Marines (HR2S). It can carry 36 fully equipped troops, with an alternative cargo capacity of 1,325 cu ft. Loading and unloading can be achieved through clamshell doors in the nose, a cabin floor hatch or cargo door located on the right side of the fuselage. Vehicles can be driven up the loading ramp into the cabin, which can accommodate two jeeps. A traversing electric hoist with a 2,000-lb capacity permits easy hoisting of cargo into the cabin and placing in desired position. Automatic stabilization equipment, semi-automatic blade-folding equipment, retractable landing gear, and a 10,000 lb-capacity automatic touchdown-release cargo sling to carry external loads are provided as desired. The five-bladed main and four-bladed tail rotors are all metal.

● Rotor diam., 72ft; fuselage length, 82ft 10in; empty weight, 20,690 lb; gross weight, 31,000 lb; max. speed, 130 m.p.h.; cruising speed, 115 m.p.h.; rate of climb, 910ft/min; service ceiling, 8,700ft; hovering ceiling in ground effect, 4,500ft; range, 230 miles (with external tanks).

S-55 This successful helicopter has a seating capacity of pilot and co-pilot and seven passengers (commercial), or ten (military). Cargo capacity is 330 cu ft and the rotor blades are all metal. The engine can be a Pratt & Whitney S3H2 of 600 h.p. or (to permit operation at 7,500 lb gross weight) a Wright R-1300 derated to 700 h.p.

● Rotor diam., 53ft; fuselage length, 42ft 3in; empty weight, 4,950 lb; gross weight, 7,200 lb; max. speed, 101 m.p.h.; cruising speed, 85 m.p.h.; rate of climb, 700ft/min; service ceiling, 10,500ft; hovering ceiling in ground effect, 2,000ft; range, 400 miles.

Umbaugh Aircraft

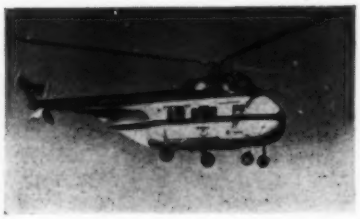
Address unknown.

Model 18 A two-seater autogyro, this has an airframe laid out along the general lines of the erstwhile Republic Seabee amphibian. A cruising speed of 100 m.p.h. is mentioned, together with a top speed of 126 m.p.h. and a "total operating cost" of six cents a mile. (Picture overleaf.)

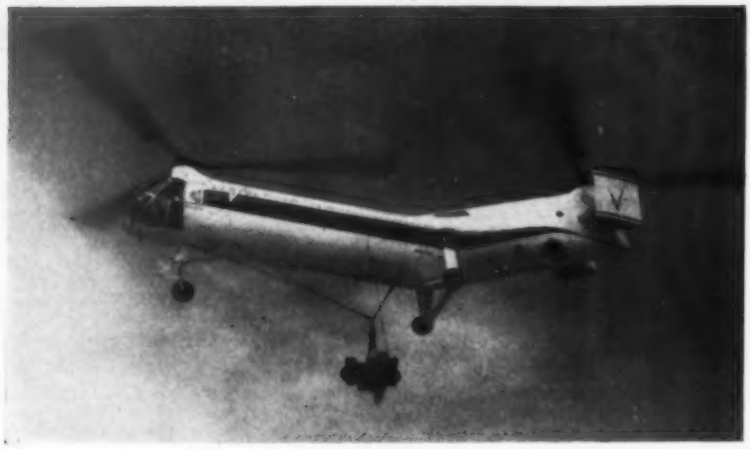
Vertol Aircraft Corporation

Morton, Penn.

Model 107 The military version of this new twin-rotor helicopter is the YHC-1B Chinook and is described as such on the next page. Civil sales are intended, however, and the aircraft should be available



Above is a Sikorsky S-55. At upper right is an S-58 and at lower right an S-56 (known to the U.S. Army as the H-37)



Vertol Model 44

Vertol Model 107

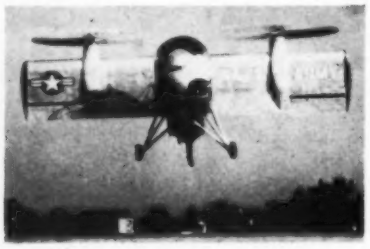
Helicopters of the World . . .

for commercial users in 1961. In the design of the Model 107 particular attention has been given to growth capability, and the prototype which is now flying is said to represent the first of the line in a family of aircraft of the same configuration which will continue to grow in size and load-carrying ability as engines of higher power become available. The machine has been designed from the start for operation under instrument flight conditions. It has been made inherently stable by mechanical means and the automatic stabilization equipment developed for the earlier Vertol 44 is adaptable to the new model. This equipment permits hands-off hovering and forward flight.

The commercial model would accommodate 25 passengers in standard airline seats. The cabin is of 795 cu ft capacity, providing nearly a third more space than in the piston-engined Vertol 44. However, although the cabin is longer, higher and wider than that of the former machine, the overall length is actually 8ft shorter. Vertol's president is quoted as saying:

"Like the Model 44, which has made more than 700 autorotative water landings, the Vertol 107 prototype has amphibious capability, as will production models. The tandem configuration eliminates the need for a boat-shaped hull because it permits a large range of trim angles at touchdown without the risk of damage to the rear rotor blades. A sealed lower fuselage is standard equipment. . . . The fuselage itself provides most of the buoyancy. Lateral stability in the water, and additional buoyancy, are provided by the stub wings and outrigger floats attached to them. Another safety feature is the location of the fuel outside the fuselage. Fuel tanks highly resistant to impact spillage are contained inside stub wings on either side of the aircraft."

Below, Umbaugh Model 18. Below right, Vertol Model 76



The twin engines can be General Electric T58s or Lycoming T53s.

● Rotor diam., 48ft 4in; max. length, 81ft 8in; empty weight, 9,100 lb; gross weight, 15,550 lb.

YHC-1B Chinook The makers claim that this helicopter "will eventually replace the Army's current inventory of obsolescent piston-engine-powered transport helicopters." A notable feature is the rear-loading ramp which can be left open in flight, permitting the carriage of elongated cargo or equipment, including certain missiles. There is a side entry to the cabin behind the cockpit, and the entire fuselage from the cockpit bulkhead to the rear-loading ramp is available for cargo and/or passengers. It is expected that a maximum of 40 troops will be accommodated. All-weather operation will be possible and particular consideration has been given to ease of maintenance. For servicing, hinged hatches in the fuselage give ready access to all components and parts. Built-in work-stands are also provided in the fuselage structure. In the ambulance rôle 15 stretchers could be accommodated. Data are essentially as for the Model 107, quoted above.

Model 44 The Model 44 is a civil development of the Piasecki H-21 Work Horse military helicopter. The Model 44A is intended for passenger/cargo operation and the seating arrangement permits 19 passengers (or 20 troops). Cabin area is 600 cu ft and bulky items can be carried externally on a 2½-ton cargo sling. The Model 44B seats 15 passengers in "airliner" comfort and provides 50 cu ft stowage for mail or cargo. The model 44C is a de luxe executive transport.

The engine is a Wright Cyclone with a take-off rating of 1,425 h.p., although turbine conversions are possible. A two-speed supercharger provides good altitude performance, and a Model 44 has taken off from a 12,000ft elevation with a 3,000 lb load and carried it for 10 miles, maintaining the same altitude.

Vertol YHC-1B Chinook

● Rotor diam., 44ft; empty weight, 8,980 lb; gross weight, 14,300 lb; max. speed, 126 m.p.h.; max. rate of climb, 850ft/min; hovering ceiling in ground effect, 5,400ft; service ceiling, 8,500ft; range with reserve, 280 n.m.

Model 76 A picture on this page, taken last July, shows this aircraft (known by the U.S. Army designation VZ-2) during transition from vertical to forward flight. The wing, and two counter-rotating propellers, are tilted as a unit through a 90 deg arc and may be moved to any angle between two extremes for short take-off or landing. Two ducted fans in the tail provide additional control in hovering. The powerplant is a Lycoming T53.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

That Unfrozen Secret

YOUR correspondent B. J. Hurren (April 24) is an old friend, but I am encouraged by Lord Montgomery's example to emphasize that the implications in his first and final sentences are his, not mine. In fact, I have never thought that our net proposals were criticized by the permanent staff of M.A.P.

B. J. H. has completely misunderstood the reason for my letter, which was to draw attention to the enormous time-lag between the initial proof of an idea and its acceptance. I can quote many other examples, including the cancellation of the supersonic M.52 in 1946 with its bi-convex thin wings, all-moving slab tail, ejection capsule, power controls, ducted fan, afterburning, telemetering, etc.; and my brother's full-scale flight experimentation on boundary-layer control between 1936 and 1939, which even now has not been matched by research projects of equal sophistication. Also, there was the 1946 supersonic Libellula airliner, the layout of which looked extraordinarily like many of the projects now being forecast for 1965.

And in passing I might mention proposals for retractable rocket launchers (1944), and a whole series of nose- and tail-loading freighters for loads from one ton to 30 tons between 1940 and the present time. With one of these (the Aerovan), incidentally, we were spreading one-ton loads of seed and fertilizer in a practical manner in 1946. Yet the Tiger Moth is still the mainstay of the agricultural world.

These examples, I think, are sufficient to prove my point that the time-lag between the initial proof of an idea and its official adoption is normally from ten to 20 years. I am sure that other manufacturers can match this from their own experience.

Returning to B. J. H., I wonder if he has realized that we could have de-iced a net of the size proposed, using a small portable petrol-electric generator light enough to be carried by two men? In this case misplaced security may have been costly in lives if, indeed, it was the real reason for rejecting the net scheme.

Shoreham, Sussex. G. H. MILES.

Supersonic Airliners

SOME time about 1925 I was at Croydon with Harry Folland, designer of the Gloster Bamel, watching it "streak" past in a race of 200 m.p.h. He forecast that this would be the speed of R.A.F. fighters within five years and of civil airliners within 15 years. The current speed of R.A.F. fighters then was about 130 m.p.h. and of airliners 80 m.p.h. (cruise) or 100 m.p.h. (flat out). So Harry's forecast seemed quite fantastic. When I discussed it with others I found the "it can't be done" brigade in full cry. Such speeds would be uneconomical, they said. And when I suggested new inventions like retractable undercarts and variable-pitch propellers the it-can't-be-done boys assured me that such extra complications would be so heavy and expensive they weren't worth considering. Now they are saying much the same about the supersonic airliner.

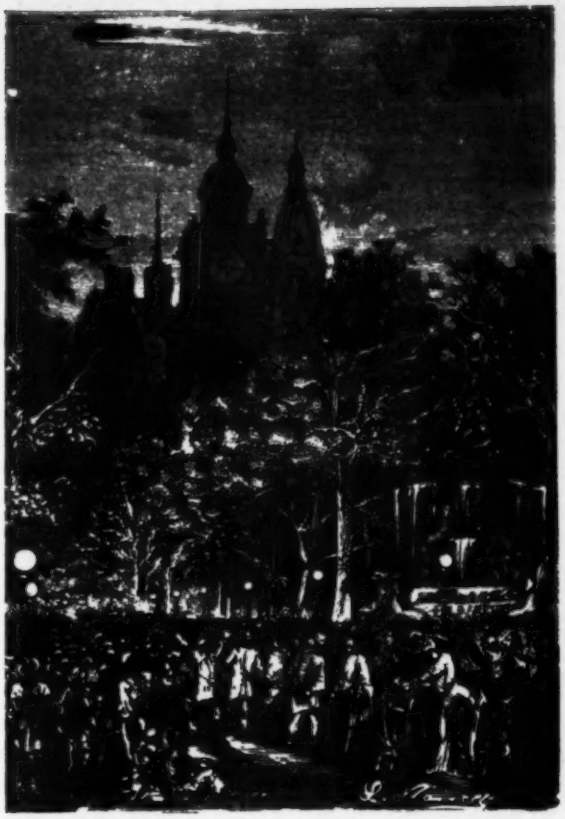
Yet throughout the forty years of airline flying the rising curve of speeds has pretty well followed Harry Folland's prediction. Sometimes it has been even quicker, as when an Me109R put the speed record at 469 m.p.h. in 1939; and the Comet 1 was flying at 490 m.p.h. in 1949 and was in service within 13 years of the German record.

Peter Twiss put the record at 1,132 m.p.h. in 1956 and, with a little bit of luck, the Lightning which has touched Mach 2 will be in squadron service by 1961. And if the curve is followed and the it-can't-be-done brigade are kept out of harm's way, we should have an airliner flying at 1,132 m.p.h. by 1971.

London, S.W.5. GEOFFREY DORMAN.

Orbiting in 1880

I WAS greatly interested in the digest of Jules Verne's astonishing book *From the Earth to the Moon* that you printed in *Flight* of October 31 last year. Your contributor was quite right in remarking that the book is now hard to obtain: it took me months to find a copy. Even less known today is *The Begum's Fortune* by the same author, wherein it is related how a German scientist constructs a monster cannon to wipe out a French-created near-Utopia in America. The fateful shot is fired: but so immense is the velocity ("nine miles a second") that the shell overflies its target and goes into orbit. The hero (a little smugly, I thought) sits down to write to the megalomaniac German: ". . . two hundred thousand dollars is not too much to have paid for the pleasure of having endowed the planetary world with a new star, and the earth with a second satellite."



The projectile misses its target (see letter "Orbiting in 1880")

Here is a picture [reproduced above—Ed.] of the projectile passing over its intended target. The English edition of the book, from which the illustration is taken, is dated 1880. Am I right in supposing that this is the first picture of an artificial earth satellite?

London, W.1. D. J. A.

Historic Hops and Flights

AFTER refusing for years to be drawn into the "first flights" controversy, I seem to be well and truly in the battle as a result of my comments on Charles Gibbs-Smith's article entitled "Hops and Flights." So I might as well display a little more "mischievous weakness" by replying to his letter in your April 24 issue, and that of Maurice Allward in the May 1 issue.

As a start, Mr. Allward is quite wrong in saying that I made derogatory remarks about the Wrights. In fact, I said in my original letter that they deserved credit for introducing science into aviation and for inspiring other pioneers with their achievements. In this, I agree entirely with Mr. Gibbs-Smith's point No. 3 even before reading his book.

On the other hand, I cannot share either correspondent's enthusiasm for the Wright biplane *as a practical aeroplane*. To my mind, a practical aeroplane is one that can be used to go from place to place and get back again, and the Wright's dependence on its catapult was one of the features that made it a dead-end design.

Mr. Allward's remarks concerning the desirability of this device cannot be meant seriously. As a start the Wright biplane was an STO, not VTO, design, weighing a mere 1,360 lb in its 1908 military form. I deplore the concrete jungle at London Airport as much as anybody; but if the alternative is to utilize the concrete in a falling-weight catapult to fling the 130-ton Boeing 707 into the air, I'll take my chance on the runways.

Reverting to more serious comments, the accident figures quoted by Mr. Gibbs-Smith in Item 5 of his letter are meaningless unless related to the number of aircraft of each type that were built and the hours they flew. For example, in a later era, only two Bell X-2s were lost; likewise only two X-2s were built, so the X-2 cannot be said to have a better safety record than, say, the Viscount.

Up to the end of 1910, the period referred to by Mr. Gibbs-Smith, 45 persons qualified for aviator's certificates in the U.K. Of these, only five are shown as having qualified on Wrights, built by Short Brothers, compared with 10 on Blériots and seven on Farmans. Of the five Wright pilots, one (C. S. Rolls) became the first British pilot to be killed within five months of getting his certificate. The only other British pilot lost in 1910 was Grace, who disappeared over the Channel in a fog.

Finally, I must hoist Charles Gibbs-Smith with his own petard

RETROSPECT

From "Flight" of May 15, 1909

View from a Flyer: Although it is obvious that comparatively only a few people can have the privilege of a flight with Wilbur Wright, quite a large number will be able to see what the country round Centocelle looks like, from the point of view of a passenger on a Wright flyer. During one of the flights made by Wilbur Wright before the King of Italy, he was accompanied by a bioscope operator, and the film obtained is now included in the series of views shown by the Urbanora Co. at the Palace Theatre, London. It constitutes a complete panorama from the time the machine leaves the starting rail, passing over fields, aqueducts and Roman ruins, to the moment when the aeroplane came to rest before the Royal party.

CORRESPONDENCE . . .

concerning Item 7. He quotes, and presumably accepts as fact, the caption from *La Nature* to the photograph of A. V. Roe on the banking at Brooklands. Surely, then, he must be equally willing to accept the following passage from the article that accompanied the illustration: —

"The money earned by the young inventor [Roe] was employed in the construction of a full-size machine: this is illustrated in our photographs. Without having yet accomplished sensational flights like those of M. Henry Farman and M. Delagrange, it has gone several times at heights from 15 to 20 m above the ground and distances varying between 100 and 300 m. These are very worthwhile results."

We have been told many times that there is no contemporary support for A. V. Roe's more modest claims to have flown in 1908. Surely this is contemporary enough?

Surbiton, Surrey. JOHN W. R. TAYLOR.

YOUR contributor Mr. Gibbs-Smith may have turned the Cody May flight into a figment of imagination, but Mr. John Taylor (April 17) has gone one better. He has turned the Wright first flight into wind.

London, W.1. F. H. SMITH.

Combined Independents?

I WAS most interested to read the item "Air Europe" in a recent edition of *Flight*. I have often thought how well this scheme would work within the British Isles, where many airlines are getting nowhere fast, to put it simply. Most of the Independents in Britain are, let us face it, futile in their efforts to do business and make money. With outdated aircraft they offer poor service and from shabby airports.

Therefore, I suggest they unite into two major companies, one for the shorter services and the other for long-range services. Then they would be in a better position to order Comets, Britannias and Viscounts in numbers and therefore better fitted to challenge the Corporations as well as to give the Commonwealth and world a service that is surely wanted.

I can well see difficulties in my suggestion and I fully realize that many would have to swallow their pride and accept this; but if it happened I can think of no better way in which to further British commercial aviation and to show that Britain leads the world.

Melmoth, Zululand. B. VANDERFELT.

Ejection in 1924

WHEN I first read Mr. Orwovski's letter on the Wolowski escape system by means of ejection through a circular tunnel in a fuselage (*Flight*, May 2, 1958) I noted that it included a description and illustration which originally appeared in Polish aeronautical Press in the mid-twenties, and a lengthy comment, containing scarcely any information regarding the seat itself. I was struck by the author's statement: "There is some evidence that at least one A-300 was modified for a proposed test [of the system] in Lublin." This seemed to me a rather doubtful revelation, as the necessary modifications involved—complete redesign of the fuselage and substantial changes in the tail unit and supporting surfaces, resulting from considerably increased weight and c.g. movement—would amount to the development of a practically new airframe round Wolowski's escape system, utilizing A-300 components. So I have made a searching inquiry into the whole matter. This brought to light some interesting facts.

The only financial help which Wolowski managed to muster for development of his idea was a small subsidy from the L.O.P.P. (Air Defence and Anti-gas League). With this he was able to construct a working model of his device. According to his own statement—stressing that the system is intended primarily for single-seaters, but could be also employed for two-seaters with side-by-side seats, and could be effectively operated even on the ground level on take-offs and landings—first practical tests with the system were those conducted on July 18, 1926, on Mokotow Aerodrome in Warsaw.

On this occasion the model device was placed in the slipstream of a Spad fighter standing on the ground with its 450 h.p. Lorraine engine fully opened. The model worked in accordance with the inventor's expectations, fully realizing his claims. Repeated tests were made in the presence of the I.B.T.L. (Aviation Technical Research Institute) officials, who on August 8, 1926, issued a special report on the experiment.

The report underlined that although the model fully confirmed the designer's anticipations the system could not be regarded as a practical proposition, mainly because of structural difficulties in installation, great weight penalty, deployment of the parachute at a great speed, and ejection of the pilot at a high velocity. Because of these unfavourable comments the League decided to make no further grants for the development of Wolowski's escape system. This was the end of the revolutionary project, which was too far ahead of its days to be properly appreciated.

These documents repudiate Mr. Orwovski's statement concerning the modification of an A-300 for tests.

London, N.9. J. B. CYNK.

A Matter of Millions

YOU may wish to correct a small, but for Americans hair-raising, error in your article, "Too Many Weapons?", appearing on page 615 of your May 1 issue.

The author, in his first sentence, says that the United States budget for 1959 provides for the expenditure of "5,564 billion dollars on continental air defence." [Not the author, but *Flight*, was at fault.—Ed.]

A footnote tries to help by explaining that Americans use the word "billion" for thousand million, which is correct. But, by the same formula, 5,564 billion would be, in America, 5.564 trillion! Thus, the article referred to should have used the decimal point for 5.564 billion, or the comma for 5,564 million.

This is made clear in the next paragraph, which points out that total expenditures for defense will be more than 40 billion dollars. If that is the case, continental air defense could hardly amount to 5,564 billion.

London, W.C.2. WALTER H. WAGGONER.

Radio Listening

I READ with amazement the letter [April 17] from the P.R.O. of the General Post Office regarding listening to aircraft radio transmissions. Is it possible that even a Government department can issue a letter like this and expect it to be taken seriously?

V.H.F. range being what it is today, do they honestly consider it a serious offence for a normal, loyal citizen to listen to aviation and police transmissions (because he finds them more entertaining than those he is paying £1 a year for) when every one of these transmissions—the aviation ones, anyway—is being monitored officially and continuously by every country in Europe—and being monitored by people who know what the more interesting code words mean, at that! And do they imagine that the latest bunch of thugs who have just drawn out £25,000 from a bank without depositing it there in the first place take notice of Section 5 (b), Subsection (i) of the Wireless Telegraphy Act, 1949, either?

I used to have a "pre-tripe-era" TV set which I was misguided enough to have modified so that my family could receive the benefits of American culture via Channel 9. From time to time on this set the normal sound transmission was swamped by bursts of static and the gum-laden accents of 180 lb he-men originating, I presumed, from Greenham Common; fortunately I did not incur official wrath by inquiring further. This was often highly diverting, especially if the picture at the time was, perhaps, the Beverley Sisters or Noddy. . . . I should be glad to know if I was risking a Flying Squad swoop on these occasions by not switching off. However, I have now disposed of this set so can sleep soundly without fear of retribution.

Farnham, Surrey. R. G. SNELLING.

FORTHCOMING EVENTS

May 9-18. British National Gliding Championships, Lasham, Hants.
May 14. R.Ae.S.: 47th Wilbur Wright Memorial Lecture, "Managing Aviation Technologies," by C. J. McCarthy.
May 16. U.S.A.F. At Homes: Bentwaters (nr. Ipswich), Sculthorpe (nr. Fakenham, Norfolk) and Alconbury (nr. Huntingdon).
May 16-18. International Sales Weekend: Cosnes-sur-Loire.
May 18. S.S.A.F.A. Display, Leeds-Bradford Airport, Yeadon.
May 21. Women's Engineering Society: "Aerial Survey Methods."
May 21-27. Institution of Electrical Engineers: International Convention on Transistors.
May 23-25. Quiberon Aero Club: Quiberon Rally.
May 24-31. Milan Aero Club: Rallie des Stars.
May 30-31. Dauphiné Aero Club: Grenoble Rally.
May 30-June 1. Air Sport Luxembourgeois: Rallie des Vins.
June 12-21. Paris Aero Show.
Sept. 7-13. S.B.A.C. Display and Exhibition, Farnborough.